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"Scire est nescire, nisi id me
Scire alius sciret."

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SOME OBSERVATIONS ON THE RELATIONSHIP BETWEEN STRUCTURE AND FUNCTION.

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BY

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"Structure is only the intimate expression of function. . . ."—*John Hunter.*

"Function implies organization adapted to the attainment of a goal."—*McDougall.*

IT has recently been said by Sir Arthur Thomson that man's body is a walking museum of relics. Being the heir of all the ages, man has inherited structures which have become atrophied because they no longer subserve any purposive functional requirement, and persist only as interesting and all too often noxious remnants.

While this is undoubtedly true, there is another and brighter side to the picture—brighter, that is, if we realize that it is functional requirement which determines structure, and uses this as its handmaid. For if this be true, man holds his future evolutionary destiny very largely in his own hands; but that future must be determined by individual effort and conscious striving, which is all-important because it leads to differentiation, lifting mankind above the level of the herd to greater heights.

The purpose, then, of this address is to support the view that Function is the cause of Structure. In our medical work we are so apt to have an eye on structure, with the subsequent derangement of function which must inevitably ensue if structure be deficient or defective, that we are very liable to fall into the error of supposing, or tacitly assuming, structure to be the all-important thing. It is our business in life for the main part to study disordered structure, and so I think there is a tendency for us to fall into a frame of mind which lays far too much stress on structure, both normal and morbid.

Structure does not exist for itself, it merely exists to subserve the needs of function. We are liable to err so greatly in this direction as to think that function can spring from structure; in fact, we go as far as to say that this or that structure, be it the heart, a gland, a muscle, bone or even nerve cell, has such or such a function, and therefore, surely, we develop in our own minds a fixed idea, which is very largely false. It appears to me that until we train our minds to appreciate our wrong attitude, and to bear always in mind the idea that functional requirements precede structure, we shall not attain anything approaching complete success in the

treatment of human beings who are suffering from what we call a disease.

We fix our minds on structures, cut sections, make pictures and think we understand the trouble. This is perhaps all the more fallacious because the method yields a half truth, and leads to fatal contentment. I do not wish to discredit the work of morbid anatomists; rather do I mean that we must ever regard structure merely as a something through which function expresses itself, and not confuse it with function itself. This is fatally easy in all forms of so-called organic disease, but perhaps most particularly so in diseases of the nervous system, especially in diseases of the mind.

It is curious that the "structural view" is so prevalent; we might with equal validity assert a loud speaker to be the cause of wireless waves, or an electric vacuum bulb the cause of light. We know well enough that such statements would be absurd, and that if we damage our loud speaker we hear no sound, and if we break our bulb we have no light. Yet each is only a mechanical means of expression of ulterior forces or waves, *i.e.* they are physical structures through which certain functions are displayed.

It is doubtful whether we are right in classifying diseases into organic and functional groups as we do to-day. Every disease and symptom is functional, though some are associated with visible changes in structure; all disease is a disharmony or perversion of function. By regarding disease in this way we shall, by studying these disordered functions, and having a fuller knowledge of physiological processes, be able to assist nature by means of (*a*) re-education, (*b*) compensation, (*c*) acclimatization, (*d*) adaptation, etc.

What are some of the grounds on which I base my opinion that functional requirements determine structure ? I think the first and most fundamental evidence with regard to this view must be sought in the evolution of mankind, and as it would clearly be impossible to trace much of this in any detail, I propose limiting my remarks almost entirely to certain aspects of the nervous system ; but before doing so I will briefly digress to give an example from a recent book of J. S. Haldane, *The Philosophical Basis of Biology*. In a chapter on breathing he describes acclimatization to high altitudes, and writes :—

" For one thing, as has been known for long, the blood becomes richer in hæmoglobin. This does not, by itself, raise the oxygen pressure in the arterial blood ; but with the same rate of circulation it lessens the fall in oxygen pressure as the blood passes through the tissues, and thus tends to raise the oxygen pressure in them, which is the essential matter. The percentage of hæmoglobin in the blood has recently been shown to vary inversely, not only with the oxygen pressure when this is below normal, as at high altitudes, but also when it is above normal, as when an animal is kept at a high atmospheric pressure, or in air enriched with oxygen. This illustrates very clearly the connection between function and structure. The bone marrow, where the red corpuscles of the blood are produced, becomes altered in structure at a high altitude, just as the blood itself is altered in structure."

It seems to me that we can trace a something, call it what we will (? wisdom of the body), which has been a continual striving towards a further end, *i.e.* something which is essentially teleological in quality and which still manifests itself in the highest achievement of the body of man, namely " the

mind." Moreover, with complexity of function comes complexity of structure. It is a platitude to say that without bones in a leg there would be no support, or that if any other important structure in the body goes wrong its function is proportionately altered. But this is merely because the said structure is the means whereby the said function is exhibited, and is not itself the function.

As we trace the development of the nervous system from its most lowly beginnings we find that the nerve cells are essentially cells which have wandered from the sensory surface which is in communication with the outside world, and form connecting-links between the outer surface and the inner motor cells; *i.e.* the nervous system is always in essence a collection of intercalated cells. In man the "neural groove" is formed by a process of tucking in a strip of the skin of the back; the edges of this groove meet, form a tube, sink into the body and eventually form the whole of the central nervous system, brain, cord and nerves. A cell at the edge of the groove may happen to remain behind, and so remain a skin cell, or it may be included in the neural groove and become a nerve cell. Therefore, for a given cell it is a matter of mere chance whether it becomes a structure with the functions of a nerve cell or a structure with the functions of the skin. The cells which are certain to be included in the formation of the groove, viz. those which lie in the mid-line, go in first and deepest, thus forming the motor cells of the cord, while those which turn in last (some of which, as we have just seen, may form nerve cells or may remain as skin cells) are intimately related to the skin, and thus form the posterior part or sensory aspect of the cord. (Fig. 1.)

We see the same arrangement even in the floor of the fourth ventricle, where the cells nearest the mid-line are motor in function, those of the sides sensory in function. In this arrangement, then, it is seen that it is function which has determined structure, and not *vice versa*.

Moreover, we see that there may be some justification for considering the skin and sense organs

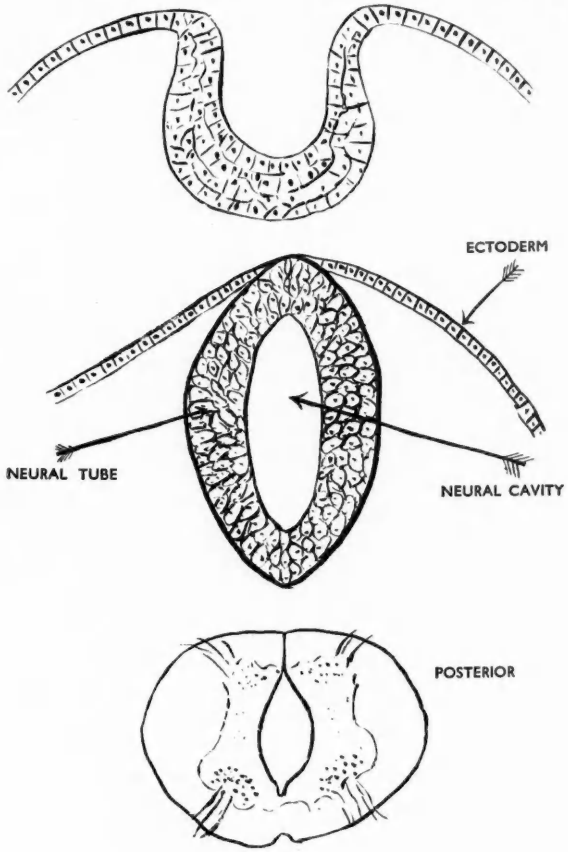


FIG. 1.

almost as an external nervous system, viz. a part of the body in communication with the outside world. Thus we must ever bear in mind the very intimate relations between the functions of the skin and those of the nervous system which is derived from it.

The external environment affects the external cells of the body from which we have seen the nervous system is derived. Various environmental stimuli impinge on the external integument (and sense organs), and as the nervous system is developed evolutionarily, structure is found to accommodate and utilize the various functional impressions which fall upon it.

I think we are quite justified in using the word "functional" for these impressions, for differences in temperature, pressure, touch, sight, hearing and smell may all be resolved into molecular bombardment or waves of something—air or ether. It is the business of external cells to be influenced by the environment, and the business of internal cells to respond to the functional waves conducted from the external. With a change in environment the functional requirements may produce a rapid change, even in the appearance (*i.e.* structure) of the epidermis (external integument), as in such animals as fish, caterpillars, etc. An octopus, for example, may settle on a rock, and then change its colour in harmony with that of the rock.

The animal, therefore, becomes by functional requirements adapted to its surroundings for self-protective or combative purposes, and its behaviour may be modified accordingly. Hence there is an intimate connection between (1) external environment —waves of many varieties, (2) skin and special senses,

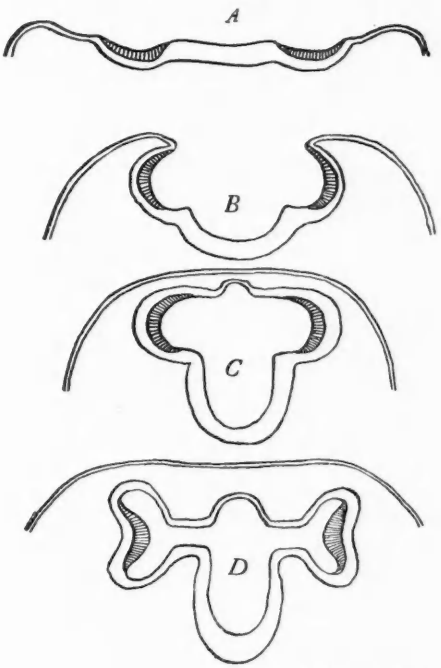
(3) nervous system and behaviour; and it is function which, originating in (1), passes through (2) and partly determines (3).

When the structure has finally been produced it is so built that it serves a particular function; but many examples could be quoted where a structure which has what may be described as a given function may quite easily be made artificially to subserve a different or even opposite function (if so required), *e.g.* a flexor muscle of the forearm may be readily converted into an extensor by surgical manipulation.

Quite early in the embryonic development of the brain groups of nerve cells are developed which have sensory functions for sight, hearing and smell. These are known as placodes. With regard to the visual placodes, these are formed before the neural tube of the brain is closed. When, therefore, this closure occurs the visual placodes are turned inwards. The structures may be perfect enough, but it is clear that if they remained in this position they would be quite useless functionally for external vision. But vision is their function, and the functional requirements therefore demand a very different structural arrangement, and succeed in obtaining their purpose. This they do by growing outwards till they meet the skin, which, however, is semi-opaque, and the requirements of function demand that this semi-opacity should be altered, and therefore the appropriate cells of the skin become transparent to form the cornea and lens. (Fig. 2.)

That some extraordinary influence is exerted with a purpose in view is seen by the fact that if a tadpole's developing eye be grafted under the skin of different parts of its body, *e.g.* the abdomen, this same purpose is responded to, and a lens formed from the abdominal

skin. The human eye, however, as it grows outwards is still inverted, and this explains why in man the retinal nerves lie in the inner side of the visual cells. (Figs. 3 and 4.) Some unknown purpose has enabled it to attain its object, in spite of this structural imperfection. When it is fully developed it can, however, only appreciate the ether-borne waves of light—wave lengths from 400 to 800 millimicrons. In fact, its function is after all a very limited one, like that of the ear, which only appreciates air-borne waves within the short range of frequency of 40



By courtesy of Messrs. Edward Arnold & Co.

FIG. 2.
Development of vertebrate eye.

a second to 4,700 a second. And yet these functions of sight and hearing, combined with the other special senses, and the sensory functions of the skin, dominate the motor system as with a purpose. For we find motor cells in close proximity to and linked up with the synapsis which transmits the sensory impressions, motor cells which are capable of carrying out the appropriate motor responses. We recognize a similar arrangement in the cord, and we see the same in connection with vision, and observe how the third, fourth and sixth nuclei are joined by the posterior longitudinal bundle, to carry out the necessary movements of the eyes.

Thus we have reached a stage of embryonic development which has innumerable and appropriate reflex responses. The pathways of these are laid down in the embryo before they are used, and they are laid down presumably as the result of racial memory. But more than this more or less automatic responsive mechanism was needed if racial progress was to be made. There appears to have been evolved a purposive effort to control movement and adapt it to fresh and unusual circumstances.

Thus new function required a fresh structure through which it could act, and this fresh structure consisted of an ever increasing and complex mass of cells, intercalated between the incoming sensory impressions and the outgoing motor responses. This new mass of cells was the pallium, which was not developed in the midst of the already existing basal ganglia, but took the form of hollow bilateral outgrowths from the brain stem. With the rise of the pallium we reach a stage of individuality, and individuality implies retention of acquired memories, conscious control, etc.

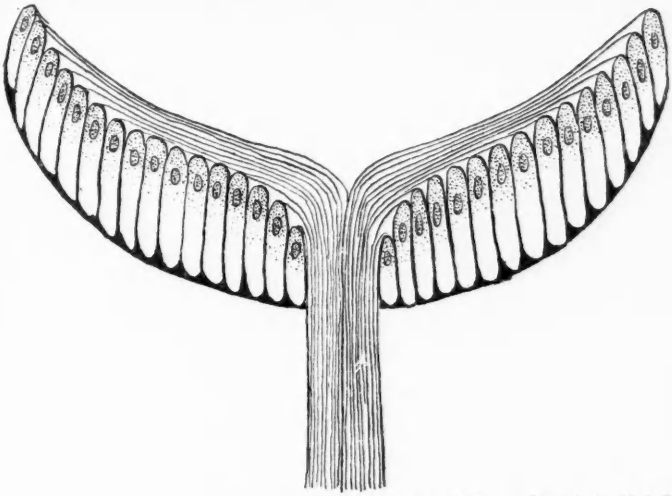


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FIG. 3.
Inverted eye of a vertebrate.

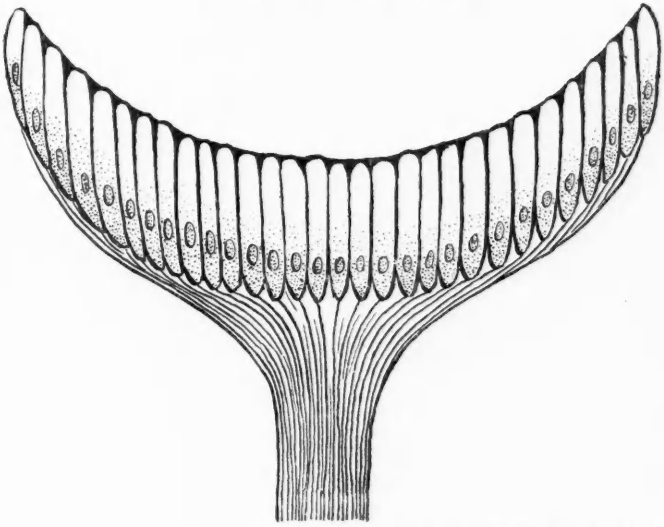

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FIG. 4.
Eye of an invertebrate.

Now concerning the volume of the brain in relation to function, it cannot be said that the larger the structure the larger the function. A whale, for instance, possesses the largest brain (about ten pounds), but a very small one in comparison with the bulk of its body, the ratio of brain to body weight being 1—25,000. The weight of a human brain is about 48 ounces, and its ratio to body weight about 1 to 60.

The convolutions of the brain are produced by the development of the cortex requiring a larger surface area, but it must not be assumed that multiplicity of convolutions *per se* constitutes any indication either of intelligence or increased function. The whale has the most convoluted brain of all brains, but a much more intelligent small mammal has a smooth, more or less unconvoluted cortex. This question of convolutions, other things being equal, seems to be dependent on the size of the animal, and the relation of the size of its brain to its body mass. The brain in an animal may be relatively a thousand times larger than that of the whale in proportion to body mass, and yet be quite smooth on the surface.

Although there has been a great deal of dispute over the question, it appears now to be conceded that the disposition of the convolutions is not in any sense haphazard, and that they are not merely formed because of the relative smallness of the cranial vault, but that the different convolutions have different cell structures, some forty of which have been recognized.

This, I think, is the important point, that these different structures have different functions, and that it is the functions which have determined the

structures, the pallial structure being the outcome of bodily functional requirements. Structure here is the expression of function, and we must beware of the fallacy of regarding the cortex as a mosaic of rigidly delimited functional areas. As the pallium develops the olfactory area becomes relegated to a lower position, while areas associated with more important functions are more fully represented in the cortex ; yet most of us know how potent a smell may be in recalling some event which was associated with a similar odour.

The final stage is the development of neutral areas, which form the association areas so vastly important in the brain of man, which distinguish it from those of lower animals. The function of the brain of man is so far removed from that of even the higher animals, that the results of experiments carried out on their brains cannot be accepted as being applicable to man, except with the greatest caution. The human brain differs from that of the higher animals not so much in the number of cells which it possesses, that is, of the grey matter, but in the very much greater amount of white matter (*i.e.* association fibres) weight for weight. It is for this reason a much better organ functionally, but it appears to be more dependent on solitary tracts, and therefore certain local lesions may produce permanent effects.

There are a few points in connection with the cortical representation of movement which, perhaps, we are apt to overlook. The face, which from an evolutionary point of view is all-important, has its position at the lower end of the precentral cortex. Immediately above that we have the centre for the hand, then forearm, arm, shoulder, trunk, hips, thighs,

legs, toes. (Fig. 5.) This, it will be observed, is not the anatomical order, which we might expect would run —face, shoulder, arm, forearm, hand, trunk, and so on. What is the reason why the order of the representation of the parts of the upper arm has been reversed? Almost certainly because the development of the important function of the hand during evolution followed the importance of the face, and therefore took up a structural position close to it. Here, surely, is a clear example of function determining structure. This arrangement is peculiar to the cortex, for as the fibres from these cells descend, forming the pyramidal tracts, a twist occurs, so that at the internal capsule the order from before backwards follows the anatomical order, and not that which we observe in the cortex, *i.e.* the fibres run in the order of the face, shoulder, arm, forearm, etc. Further, there is one other point to be observed. These fibres arise from the Betz cells in the cortex; those for the face, which are lower

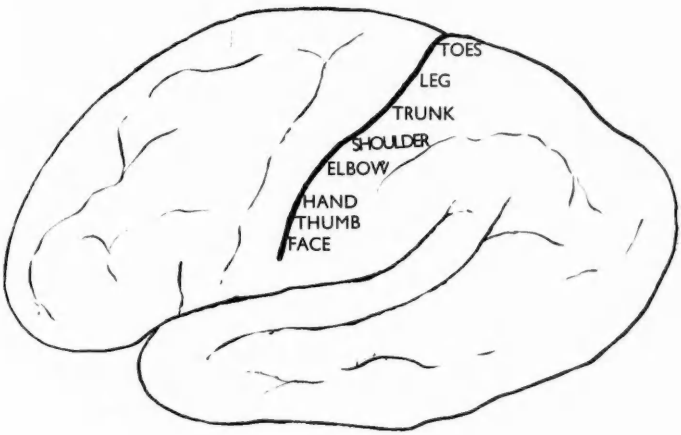

FIG. 5.

in the cortex, have a short distance to travel before they form their synapsis at the facial nuclei. Those for the legs have a long distance to travel, from the top of the cortex to the lumbar area. We find in accordance with this that the Betz cells which subserve the nutrition of the leg fibres are very much larger than those which subserve the nutrition of the face fibres, with a gradual diminution in size of the Betz cells of the cortex as we pass from leg to face area. (Fig. 6.) Here is another example of increased requirements of function receiving greater structural mass. It will be agreed that the functional capacity of a hand and arm is much greater than that of a leg; yet the Betz cells which are concerned with the mechanism of movement of the hand and arm are smaller than these corresponding cells for the leg. This again indicates that it is not so much the cells as the functional associational pathways which are of even more importance than the cells.

It might be inferred from such observations that there are definite localized motor areas in the brain, for face, arm, leg and so on, from which impulses arise causing movements in these different parts. This view, which was at one time held, cannot be sustained any longer. Accumulating evidence appears to prove that the functions of the brain are very much more widespread throughout its structure than was formerly supposed, and that it tends to function much more as a whole than was thought, and probably the so-called localizing areas are not spots where movements or feeling are initiated, but rather areas which merely subserve the transmission of impulses concerned with these special movements or sensations.

We must not suppose that a given function resides in a given structure, *e.g.* that a cortical motor arm area

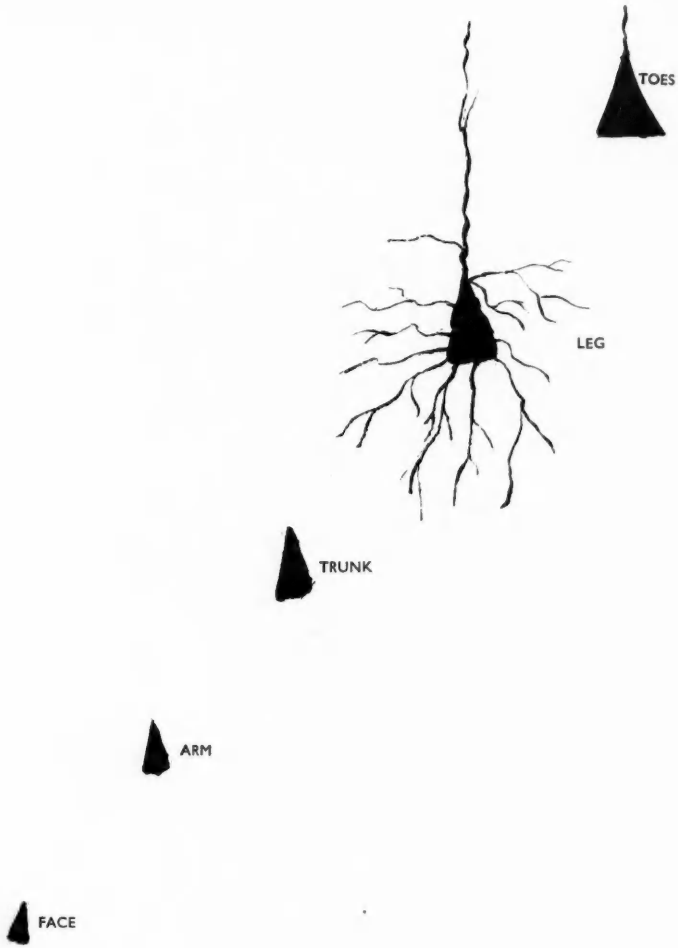

FIG. 6.

Betz cells.

can only subserve movements in the contralateral arm; that that is the normal course of events all will be agreed, but the requirements of the body may force this structure to take up other functions. A large number of most interesting experiments have been carried out which bear on this question, which seem to point to the view that open pathways are more important than localized areas. In other words, here again structure will be subservient to function. A given area of the cortex may even be made to assume additional functions.

James Collier, in the Savill Memorial Lecture of 1929, describes a class of experiments carried out by Kennedy, Osborne and Kilvington which prove this. They are too lengthy to describe here in detail, but I will quote from him the following example:—

"They (Osborne and Kilvington) found it possible to divide the left middle cord of the brachial plexus in the dog, and, cutting the proximal end very long, to pass it under the trachea and unite it to the peripheral end of the right middle cord, also cut very long. The central end of the right middle cord was enclosed in a blind rubber tube to prevent sprouting. This dog recovered well; it could walk and run naturally and could use either forepaw to hold down a bone. A very long time was allowed to elapse after recovery before this dog was examined. It will be observed that the extensor afferents and efferents of the right forelimb had been thrown into the left middle cord, and therefore on to the right motor cortex.

"Stimulation of the right motor cortex now gave movements in both forelimbs. In the left there was extension of paw and flexion of elbow, in the right contraction of the triceps and extension of the paw.

Stimulation of the left cortex produced movement in the right limb only, entirely excluding any movement in the triceps or paw extensors. To put it shortly, the cortical points for extension of the right forelimb of this dog had been removed from his left hemisphere, and had been implanted in his right hemisphere. The left middle cord was then divided high up, and its distal end stimulated, when exactly the same movements occurred as had resulted from stimulation of the right cortex." (Fig. 7.)

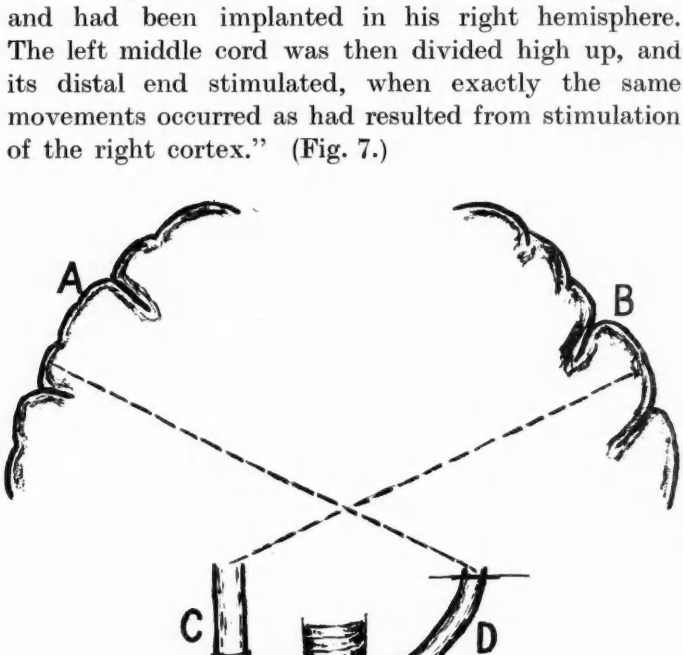

FIG. 7.

A—Right cortex.
B—Left cortex.
C—Right middle cord.
D—Left middle cord.

Certain rules are therefore formulated :—

1. " If a peripheral nerve is cut the corresponding motor cortex loses its electrical excitability. (This, I [James Collier] submit, is only another way of saying that if you block an efferent path near its periphery there can be no result from stimulating that same isolated path, as it leaves the cortex, and I infer from this that the results of stimulation in the motor area are those of stimulation simply of an outgoing path and not stimulation of a centre of function.) "

2. " It does not matter to which area of the motor cortex, nor to which hemisphere you transfer your peripheral innervation ; complete recovery of function occurs — motion, co - ordination and sensibility — provided the path in and the path out are fully restored. (From which I infer that the path is much more important than the whereabouts in the cortex.) "

3. " In this recovery of function the afferents must be all important."

For without the different proprioceptive impulses perfectly co-ordinated movements would not be " trained into " the parts of the cortex which take up their fresh functions.

The brain is a structure into which myriads of impulses, silent (proprioceptive), distant (exteroceptive), visceral, conscious and unconscious are perpetually pouring from every direction, there to be transformed at different levels into reflex actions, cardiac and respiratory movements and volition. While the lower centres are fixed, the upper are much more mobile than was at one time supposed. The pathways along which these impulses can run are all important, and are composed of synapses and association fibres which

form the bulk of the brain structure. Here function is transmitted, but neither the structural pathways nor the cells are function itself.

I have just said that the lower centres are fixed, but even at this low level do we not daily see an example of altered function, while the structure of the reflex arc itself remains intact, in the extensor response of the great toe when pallial control is cut off ? Is not this an exhibition of atavistic reversion, which is seen also in the babe before the pallial fibres are myelinated ?

If, then, we can so regard the functions of the brain in relation to such relatively gross properties as movement, sensation, equilibrium, vision, and so forth, we shall not be content without a few inquiries with regard to the relation of the structure of the brain to the mind. It seems clear that the brains of many aments are defective in the number and development of their cortical cells, especially in the pyramidal and fusiform layers. The association systems also show a very definite diminution.

Various observers have also attempted to show that different mental disturbances are associated with structural alterations in cells at various levels in the cortex. But does this mean that different mental traits or characteristics can be bottled up, as it were, in different cortical cells ? The idea savours too much of the phrenologists.

I have recently read that " cellular studies of the cortex suggest that there are present richly receptive focal points of intelligence." This sort of remark implies that intelligence can or will be resolved into a question of chemistry and physics, and that intelligence has a physical basis. Let us hear, therefore, what such a distinguished physicist as

Sir A. S. Eddington has to say with regard to such a view-point :—

" Starting from æther, electrons and other physical machinery, we cannot reach conscious man and render count of what is apprehended in his consciousness. Conceivably we might reach a human machine interacting by reflexes with its environment ; but we cannot reach rational man morally responsible to pursue the truth as to æther and electrons. . . . We have followed the latest developments of relativity and quantum theories because they contain the conceptions of modern science. . . .

" What, then, is the physical basis of nonsense ? The problem of nonsense touches the scientist more nearly than any other moral problem. If the brain contains a physical basis for the nonsense which it thinks, this must be some kind of configuration of the entities of physics — not precisely a chemical secretion, but not essentially different from that kind of product.

" It is as though when my brain says seven times eight are fifty-six its machinery is manufacturing sugar, but when it says seven times eight are sixty-five the machinery has gone wrong and produced chalk. But who says the machinery has gone wrong ? As a physical machine the brain has acted according to the unbreakable laws of physics ; so why stigmatize its action ?

" This discrimination of chemical products as good or evil has no parallel in chemistry. We cannot assimilate laws of thought to natural laws ; they are laws which *ought* to be obeyed, not laws which *must* be obeyed ; and the physicist must accept laws of thought before he accepts natural law.

" *Ought* takes us outside chemistry and physics.

It concerns something that *wants* or esteems sugar, not chalk, sense or nonsense.

"A physical machine cannot *esteem* or *want* anything; whatever is fed into it it will chaw up according to the laws of its physical machinery. That which in the physical world shadows the nonsense in the mind affords no ground for its condemnation. In a world of æther and electrons we might, perhaps, encounter *nonsense;* we could not encounter *damned nonsense.*"

At any rate, there is a school of thought which lays the greatest emphasis on structure (cortical architecture) in relation to disease of the mind. But, excluding amentia and dementia, most of the upsets of mentality as seen by the neurologist are associated not so much with changes in the cortical cells as with lesions in the association systems. It seems fair to say that this school holds an essentially mechanistic view of the mind, reducing it to an extremely complicated form of machine.

Mental life, they say, is entirely dependent on the mechanistic processes of our brains and bodies. There appears to be little doubt that the state of mind influences the processes of the body. The bodily effects of fear and other emotions are well known, and undoubtedly structural changes in vital organs frequently follow prolonged and intense mental strain, anxiety, etc. Conversely, chemical alterations in the blood, due to excess and diminution of internal secretions, gout and other metabolic disorders, disturbances of the liver, stomach and so forth, do, we know quite well, alter the mentality of the patient.

The mind, therefore, may act on and be acted on by almost every part of the body—but this does not

tell us what mind is, or whether or not it can utilize the structure of the body with a purpose in view, *i.e.* teleologically. If it can do so surely the purely mechanistic or structural view breaks down.

Now man can form an ideal, work for an object, strive towards it, and modify the means he adopts to attain his end. On the intellectual side he has faculties of reasoning, judgment, perception, imagination and so forth, all of which tend to produce action. Put in another way, these are functional factors which act as the exciting causes of action, because "function implies organization adapted to the attainment of a goal."

As McDougall says, "The essence of our mental life, in its aspect as intelligence, is not a mere succession of sensations, ideas or representation of things, but a *thinking* of things and of their spatial, temporal and causal relations, and such *awareness* of relation plays an essential part in the guidance of our actions."

The striving towards an end or goal is purposive, and the more obstacles encountered in the way, so much the greater is the energy which is exerted to attain the desired end. Moreover, there are four characteristics of such striving: (*a*) adaptability, (*b*) persistence, (*c*) increase of energy in proportion to the resistance offered, and (*d*) cessation of energy when the goal is attained.

These imply foresight, forward temporal reference, spatial relations and causal relations, properties which are completely at variance with those of any machine.

The function of memory is the determination of the course of present action in accordance with past events. Mind itself has been described by those holding

a mechanistic view as the working of associative memory, and all mental activity, under this view, is determined by the material structure of the brain. However, the facts of memory do imply that past events have left some mark upon the organism, which endures and plays a part in settling present action. But it also plays its part in guiding this present action with regard to the future; in fact, the primary function of memory is that it may be used for anticipation, or the striving towards some goal, which is the primary characteristic of all intelligent purposive action. So that although memory is determined by the past, it works towards the future, and in this striving " becomes Imagination, the function in which mind manifests most clearly its creative power."

Here we must consider a few points in connection with the basis of memory. What is the nature of the " traces " or marks upon the organism which have been left by the function of memory ? Biological mechanists say the organization of the living creature is altogether material, and that nothing counts but matter and its spatial arrangement. Therefore, according to them a desire, an intention, or a sorrow must be in some way material. They also hold that there is always material continuity of vital organization, derangement of the material structure always resulting in disturbance or abolition of all evidence of organization. They state that function is correlated to material structure. This may be true, but can only be wholly true if the correlation be perfect. If it can be proved to be perfect, then function is entirely determined by structure.

Now, it has been shown that the spatial arrangements of a developing embryo may be grossly distorted, and nevertheless later on may be rectified and return

completely to normal. Therefore there must be something more than the material structure to produce this result. Similarly the leg of a newt may be cut off at any point, and will then completely regenerate. Where is the structure which produces this function of regeneration? Moreover, another limb may be cut off while the former is regenerating, without in any way interfering with the regeneration of the former, and will itself be replaced by a perfect limb.

With regard to the effect on the mind, especially on memory, of lesions in the structure of the brain, no exact localization of mental functions has been discovered. Furthermore, in connection with memory one may hear a speech, which is not, however, recorded in the structure of the brain, as it might be on a gramophone record; no single sentence of the speech may be able to be recalled, but the speech may be fully remembered, because the exact meaning of it was appreciated. Our present knowledge could not explain this in terms of structure.

The correlation between brain structure and mental processes has not been established. More and more it appears that the brain functions as a whole, and as we have seen, impaired functions may be restored and become correlated to parts of the brain other than those with which they were formerly correlated. Consider a case of complete hemiplegia, due to a complete destruction of an internal capsule by hæmorrhage. We know that such a patient may be almost completely restored functionally, even though his cortex on the affected side has been entirely and permanently cut off by the lesion. His functional recovery must mean that some other part, presumably the other cortex, has adopted fresh functions.

Moreover, the patient can walk, *i.e.* the two legs do not move synchronously but alternately. Therefore, presumably the homolateral cortex has not only taken on an increased function, but an entirely new one. The function therefore showed a relative independence of its structure. Whatever function may be, its nature is such that it cannot be revealed to us in the form of structure.

There is a strong analogy between *heredity* and *memory*, but neither the one nor the other has, as yet, been explained on solely structural grounds. McDougall says that neither the normal processes of morphogenesis nor the self-regulation of living bodies can be explained in terms of material structure alone, and he writes :—

"Consider the autogenesis of a particular moth from the egg. The egg is a minute speck of protoplasm containing in a semi-fluid matrix a number of distinguishable microscopic particles of genes, arranged in a fairly definite pattern ; and no doubt each of these particles may have a definite material structure or pattern of arrangement of its constituent elements, whatever these may be—and there is good evidence that each gene is somehow necessary to the development of one or more of the features of the adult organism. The egg cell divides again and again, masses of cells become differentiated to form special organs, each vastly complex and exactly fitted to play its part in the economy of the whole : and the whole assemblage of organs, which is the caterpillar, displays complex instincts. Then a process of resolution sets in. The organs are resolved into a mass of cells within a bag of skin, a mass that seems little more than a drop of pus. Then a new organizing process begins—new organs gradually form, all different from

those of the caterpillar, many of them entirely new and complex; and then the moth emerges to display a new and entirely different array of complex instincts."

Then, again, in connection with the self-regulation of living bodies, what force is at work which sets in operation the formation of antimicrobic and antitoxic substances? If the body could, when invaded by microbes, elaborate some general antimicrobic serum it would be a marvel. But that it does in many cases produce an antimicrobic substance which is specific to a given microbe and only to that one is, to say the least, extraordinary; more particularly when we remember that it may never have encountered that particular microbe before. The same with antitoxic substance; some most complicated chemical toxin gains a foothold in the body, and some force sets to work to produce a most complex chemical substance which has a perfect neutralizing effect on that particular toxin. What is the force which does this, and what is its main characteristic, if it is not purpose?

Professor Francis tells me that the study of the changes produced in organic chemical substances by their passage through the animal organism has led to the generalization that such changes tend to the formation of less toxic bodies, and has supplied me with many examples. This again is a very remarkable fact, when we bear in mind that the body has had no previous experience of such substances, and such a substance may be an entirely new synthetic product, which may never have existed before.

Many events are so common and so perpetually seen that we take them as a matter of course, and hear little or no speculation as to why or how they occur. I refer to such things as the healing of a wound, and

the extraordinary events which take place in the mending of a bony fracture. Such events would not have occurred had there been no wound or no fracture, and we must admit that they are purposive in character, *i.e.* teleological functions which mould structure according to their will.

As in the body we see these purposive functions at work, so in the mind are the main functions teleological. No one knows what life is, though each of us has some acquaintance with it; and just as the properties of iron filings in a magnetic field could not be deduced merely by examination of the filings, so, probably, the properties of the chemical components of the body cannot be understood without postulating some unknown factor outside them which may be called a "life field."

A very brief allusion must be made to telepathy, a condition in which almost certainly there is a direct influence of mind on mind, irrespective of distance or space. This phenomenon appears to depend on intensity of interest, or great sympathy between the persons concerned. The mental activity of one person may therefore be influenced by the mental activity of another without the intervention of any known physical structure. If this be so, we must be very chary before we insist on any causal relation of cell to mind in the brain. We must beware of being blind to the processes of actual life, while we are carried away by our observations of microscopic structure. The only way in which we can escape from the acceptance of telepathic phenomena is to disbelieve the careful and critical evidence which has been collected and impartially sifted by some of the most competent investigators.

To sum up, the body wants to do something, and

so it produces a structure by means of which it may carry out its wish. The whole process is a purposive and teleological one. This is its striving, and to attain its end it uses many and diverse methods.

In this address I have tried to show that function implies a striving towards some end, and to attain its goal it develops and modifies structure. The structure so obtained is the substance through which it is manifested. Does it not follow that if functions are energetically and persistently used through a long series of generations the suitable pathways for the exhibition of those functions will be proportionately free or facilitated in the offspring? Further, if this be so, may not modern legislation which removes personal responsibility, and diminishes individual striving, be a profound biological fault, leading to racial deterioration?

I have quoted the views of biologists, physiologists, anatomists, neurologists, psychologists, chemists and physicists. I will end by a quotation from the late Poet Laureate, a philosopher, poet and doctor:—

"Thus must all kind of stimulus hav come some way
across the misty march-land, whereon men would fix
their disputable boundary between Matter and Mind,
—as every sensation must suffer translation
ere it can mediate in the live machinery
of any final cause or purpose: whence 'twould seem
that science went astray thinking to appropriate
some nervous reactions wholly to her material sphere,
and rather should have thought to extend the mental field."

Robert Bridges, "The Testament of Beauty."

The writer acknowledges his indebtedness to the work of Wood Jones and Porteus on "The Development of the Nervous System" in *The Matrix of the*

Mind, from which Figs. 2, 3 and 4 are taken, and also to *Modern Materialism*, by W. McDougall, both of which he has used freely. Among other books of reference are :—

J. S. Haldane, *The Philosophical Basis of Biology.*
A. S. Eddington, *The Nature of the Physical World*
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J. H. Woodger, *Biological Principles.*
J. S. Collier, The Savill Memorial Lecture, 1929.

HUMAN IMPROVABILITY.

BY

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THE problem of human improvability is as interesting for discussion as it is difficult of solution. It is essentially a problem of relatively recent origin. For the notion of progress was only generally entertained when that of evolution came to be accepted. In ancient times mankind was conceived as tossed hither and thither in the grip of fate or fortune; while in medieval times mankind was regarded as being perpetually steeped in sin until the dawn of a Messianic millennium.

Perhaps the greatest difficulty which confronts us in approaching this problem is that of defining improvement. Unless we can clearly determine whether any change makes for improvement, how can we hope to ascertain whether or not human improvability is possible?

I think that at the outset we may advantageously distinguish "progress" from "improvement." Every step in evolution, *i.e.* every change making for increased differentiation of function, increased co-ordination of parts and increased integration of previously independent units, may be accepted as progress.

But improvement implies something more—namely, "betterment." Unlike progress, improvement is bereft of any scientific, objective criterion. We have to judge of improvement by subjective, ethical criteria. We have to ask ourselves whether the change leads not merely from a lower to a higher plane of organization, but also from a lower towards a higher ideal. Improvement has thus a significance relative to the user of the term. What one person will regard as an improvement will not necessarily be so regarded by another. We have also to consider each change, not in isolation, but in relation to all other relevant changes, and in relation to the total environment, if we are to regard it as an improvement.

The prevailing current biological view is that all changes in living form and function are evoked by accident and are perpetuated by heredity and by their suitability to the environment. On this view we might regard improvement as consisting in a more perfect adaptation or adjustment to our environment, physical and social. Certainly in the conquest of disease, in the discovery and introduction of more highly sanitary conditions, we of the modern Western civilization may, in this sense of the word, be said to be "improving." But improvement from this aspect may be accompanied, as we are all aware, by deterioration from another, *e.g.* by the increased survival of the less fit and the unfit. Yet here once again we have to turn to the reverse aspect: the greater care of the infirm may imply a social, moral improvement, in developing the "instinct"—shall we call it ?—of protecting the weak and in reducing the sway of ruthless selfishness and of brute force.

This notion of social improvement leads us to yet another conception of improvement—as measured by the extent to which we carry out in practice our moral rules and ideals. Codes of morality may vary from age to age, according to social environment and other factors. May not the true criterion of social improvement be not merely the nobility of our moral ideals, but also, and rather, the extent to which we succeed in putting them into actual practice ?

If, finally, we bring together two of these different meanings of improvement which we have been considering—the idea of improved social evolution on the one hand and that of improved adaptation to environment on the other—we are confronted with the following conceivable situation. There may gradually be evolving a state of society so complex, so exacting, so strenuous and so full of conflicts that man may be unable to adapt himself to it as he did in the easier, slower life of centuries ago. He may ultimately be destroyed by the weight of his social environment, just as perhaps the huge dinosaurus perished through its own unwieldiness. So far from progressing and improving, man may be forced to revert to simpler conditions for his own salvation.

It is possible, however, to hold quite another view of the determining conditions of progress and improvement. Many find it difficult to believe that the evolution of species has occurred through purely accidental variations in the germ plasm and in consequent structural and functional progress, better fitted to life's environment. To them it seems as necessary to invoke the presence of some unknown direction and purpose or end throughout evolutionary

progress as it is to invoke direction and purpose or end in accounting for the composition of one of Shakespeare's plays or of Titian's pictures. The creation of new forms of organisms seems to them to be as impossibly accidental as the creation of masterpieces of art or as the discoveries in physical or biological science. On this view some unknown direction, purpose, or end is inherent in the history of the universe. It is a view which almost inevitably leads to a belief in general, and particularly in human, improvability.

But such a faith, however robustly held, is hardly adequate for a satisfactory solution of this problem, especially in a scientific gathering like that which I am now addressing. I think that you may be interested in hearing an account of my own experiences among primitive peoples in relation to the problem of human improvability. If we consider the most primitive peoples alive to-day, we cannot fail to be struck with the elaborate social institutions and regulations governing and restricting their life and conduct. The old idea we used to entertain of the greater freedom of the savage compared with civilized man turns out to be false. No one among ourselves is so fettered in his actions as primitive man by the dictates and authority of social and religious tradition and custom. Our liberation from such of them as are now judged useless or harmful, and have vanished through disuse, is surely one of the improvements effected by modern civilization.

Over thirty years ago I took part in an anthropological expedition to the islands of the Torres Straits, lying north of Australia between it and New

Guinea, and to Sarawak in Borneo, where we made a study *inter alia* of the mental powers of these peoples. The differences we found between them and civilized peoples as regards intelligence did not impress us as being appreciable. In those days intelligence tests were not available. But even if they had been in vogue they would have proved useless, for the results of intelligence tests can only be compared when they have been applied to individuals who have been born into and have grown up in the same social environment.

I have been told that some years ago the Americans attempted to prove the inferior intelligence of the Japanese by applying American tests of intelligence to Japanese children in Hawaii. The Hawaiian Japanese retorted by framing and standardizing tests of intelligence suited to Japanese, instead of to American culture and civilization. By applying these tests to American and Japanese children, they had no difficulty in proving that the American intelligence was inferior to the Japanese. Even within the United Kingdom the same intelligence tests are not comparable, say, between England and Scotland. So much depends on conditions of environment, education, etc.

Nor would the results of any tests we may devise to-day for intelligence be comparable with the results of the same tests applied to the same community one hundred years ago or one hundred years hence. Each generation has a language of its own, an education of its own, an environment of its own. And as no tests can be devised which are independent at once of language, of knowledge and of manual actions indicative of the exercise of intelligence, we are

powerless to determine by scientific methods whether intelligence is improving within the same community from one century to another, or whether it is at the present day higher in one community, nation, or race than in another.

Let us return now to our Torres Straits islanders. This expedition of which I was a member examined *inter alia* the differences between the natives of the Torres Straits and Sarawak and peoples of our own civilization as regards sensory acuity—keenness of sight, hearing and smell, for instance, and sensitivity to pain. These (with the exception of the last) turned out to be relatively slight. The wonderful stories brought back by travellers as to the extraordinary visual powers of the savage seem attributable merely to his far more intimate previous knowledge, which enables him to interpret dimly-seen objects with a correctness which seems marvellous to the less expert European stranger. On Murray Island in the Torres Straits lived one white man, a Scottish school teacher, who gave instruction to the native children. In arithmetic I found him teaching them such now antiquated subjects as "practice" and "parcels." He told me that his pupils did rather better in arithmetic than corresponding children in our own country, and this despite the fact that in their own language the Murray islanders possessed only two words for number—"netat" for "one," and "naes" for "two." "Three" was expressed by "netat-naes" (one and two), four by "naes-naes" (two and two).

Such results may make us at first sight, at least, wonder whether savage peoples would not reach the mental levels of more civilized people if only they were

born in the latter's civilization. For there can be no doubt that both animals and plants may quickly alter when removed to a new environment, and that there is a wider range of possibilities than has been hitherto generally supposed in the development of what is inherited by the organism, the precise nature of that development being determined by the nature of the environment to which it is subjected. Changes in food, soil, temperature, humidity and the like affect the final result of an organism's physical development. May we not suppose also that man's mental and moral development depends not so much, or at all events not merely, upon what is inherited, as upon the relation between that inheritance and the physical and social environment in which the individual grows up? How often do we ascribe the moral defects and delinquency of a young person to the fact that he never had a fair chance of living decently! May we not entertain the view that man's improvement is largely due merely to a certain innate improvability, the precise expression of which in turn depends on the environment in which he grows up?

During a subsequent visit to South and East Africa I had the opportunity of several talks with Europeans whose lives had been largely spent in teaching the coloured races there. With surprising unanimity their opinion was that, given equal opportunities, their coloured pupils promised to equal the achievements of any white population. They were vigorous in their denial that there was one education needed for the negro, another for the European. For them negro and European possessed equal mental capacity and equal powers

of achievement, given equal opportunities of development and environment.

Against this view must be opposed the oft-quoted experience as regards the negroes in the United States. Despite several generations of education, not a single pure-blooded negro has achieved anything approaching first-class greatness, so it has been stated, judged from the white man's standards. Booker Washington and other similarly eminent coloured individuals have had white blood in their veins. To this, however, it may be objected, first, that there are so many negroes in the United States who are not pure, and consequently that we should not be surprised that those who succeed are not pure; and in the second place, that the environment in which they grow up and are educated fails to give them an opportunity equal to that enjoyed by white persons. They are taught by less efficient, often coloured teachers, grow up amid negro traditions and in negro society, and are regarded with contempt, aversion and ostracism by those whose civilization and culture they are expected to adopt.

On the other hand, the force of heredity and the impossibility of radical change in what is inherited must not be neglected. Nothing will stop true genius or the really criminal mind from asserting itself, whatever be the environment against which it may have to struggle. This is as certain as the fact that the very best education is powerless to change the innately mental defective into a person of even moderate intelligence. Why, then—we may well ask—is it that despite all the disadvantages under which he labours, a pure-blooded negro has not occasionally arisen who has equalled the highest genius of the

white race in scientific discovery or in artistic creation ? Are we not bound to conclude that, however nearly alike may be the average abilities of two such different races, they differ, at all events in the extent of exceptional ability or in the temperament and character which permits of the best use of their ability ?

Long-standing differences of climate are doubtless largely responsible for the differences in colour between the black and white man and for the other physical and the temperamental differences between them, and between one European nation and another, and for the differences between their social institutions and culture. Can we, therefore, expect a relatively quick adaptation of a member of the lower races or of any other civilization to our own civilization, any more than we can expect a rapid change of his skin colour from black or brown to white ?

On the other hand, why should one primitive race or people remain apparently stagnant or show decadence in social conditions, whilst another steadily develops a civilization rich in scientific discovery and in general cultural progress ? Must this not be largely due to the influence of changes of climate and other features of environment in producing, selecting and stimulating those most fitted to contribute to social progress, especially by developing such internal secretions and consequently such temperamental, intellectual and moral characters as are best suited for initiating and accepting such advance ?

For my part, I cannot but believe that there are profound racial differences which have thus produced, and been produced by, cultural differences, and that

these racial differences will persist long after attempts have been made, as modern civilization is now attempting, to bring all races under the same social environment. And I believe that these differences between white and coloured peoples constitute generally an improvement in the former, in so far (according to our original definition) as they relate to a higher culture and to a higher moral.

Let us now turn to another aspect of the problem, the changes occurring in our own race and civilization. We are often told that the present age, so far from being one of improvement, is an age of degeneracy, or that it is at all events an age which should be replaced —and replaced profitably—by some previous one. For my part I see much confusion of thought and personal prejudice in such a view. Transitory reverses in moral conduct are here regarded as evidence of permanent deterioration. The present lessened prospects, comfort and happiness of those who previously enjoyed light taxation, loyal and contented servants, large houses and estates, naturally blind them to improvements occurring among the large masses of our modern people. They think only of the vulgar manners and of the refusal to shoulder their own old responsibilities which they see (temporarily, as I maintain) among the *nouveaux riches* who have supplanted them.

The good old days, like the good old Christmas weather, must be regarded largely as a delusion. Neither will withstand any approach to exact inquiry. The monotony involved in modern industrial conditions and the evils of mass production are largely exaggerated, and, indeed, are relatively negligible in

comparison with their compensatory advantages. Compare the conditions under which manufacture was once conducted in insanitary cottage homes with the present conditions of the most progressive, well-lighted factories, where welfare work and the investigations of the industrial psychologist and physiologist are in full swing—all directed to ensuring the greater physical and mental comfort of the worker, to reducing needless worry, irritation, boredom and strain, and to placing the worker in that kind of occupation for which he is mentally and physically best suited. Consider what mass production has achieved in enabling the standard of living of the masses to be raised, in providing them with shorter hours of work and with recreations (*e.g.* the wireless, the gramophone, the film, the charabanc, the motor cycle)—recreations far in advance of those which the so-called working classes of bygone generations could afford, desire, or even conceive for themselves.

True, it is said, and perhaps some of you will insist, that mass production and mass education destroy individuality and reduce us all to a common standard of uniform inferiority. But I maintain that this view is—in the long run—a mistaken one. Not long ago the maker of some of the finest modern tapestries now produced in this country told me that his designs were frequently being imitated in Germany and sold there cheaply as copies of his own designs; but to my surprise he added that these advertised imitations really helped the sale of his own choice products, inasmuch as whenever a German had acquired enough wealth he preferred to buy the genuine British article

in place of the cheaper, inferior mass-production copy of it already in his possession.

So it is, I hold, with the mass production of music by gramophone records or by wireless. The concert halls have not thereby suffered: that is generally admitted. You may not infrequently hear the street-boys of to-day whistling high-class music. Not long ago I heard a young barman at a small remote country inn singing an air from one of Saint-Saëns's operas. And when I asked him how he had come to learn it, he told me that he possessed a gramophone record of it. So it is too, I believe, with the cinema films; they offer an inducement to those of the working classes who are endowed with the best taste to exchange mechanized for living artistic productions and to visit good plays at the theatre.

Compare these mechanized products, however deplorable they often are, with the recreations available for the bulk of our people two or three generations ago. Remember, too, that good taste abounds in every social stratum, as in every level of civilization, awaiting only encouragement for its exercise. Many years ago I used occasionally to help the late Canon Barnett by attendance at his annual exhibition of modern paintings in Whitechapel; and almost invariably I observed the largest crowds of these East-End workers congregating around the best pictures, *e.g.* those of Watts, Millais and other first-rate artists of the day. Only a short while ago I heard of a poor working lad who was so impressed with some Bach music which had been played to him and his friends that he asked whether they could not themselves form an orchestra in order to play Bach music.

Mass production may produce temporary ill-effects; it calls, for instance, temporarily in factories for armies of machine-feeders engaged on the most monotonous tasks; and by replacing much human labour by machinery it increases unemployment temporarily. But presently production is cheapened; the demand for the product is increased; and the number of workers needed may rise by leaps and bounds. And presently the dull work of machine-feeding is itself performed mechanically, and the demand increases for a larger supply of machine-minders—*skilled* workers to look after the increasing number of machines. Ultimately more machinery means a greater demand for skilled workers and the abolition of severe physical or tedious labour of a type that is fast becoming regarded as unfit for civilized humanity. So it is, too, with the mass production of clothes. First it raises the standard of living, enabling those to buy articles who could never before have afforded them. Next it enables those possessing taste and an adequate income to demand articles of better manufacture, greater individuality and artistic merit, who in former days would never have had the opportunity of doing so.

The same holds for the mass provision of educational facilities. These are at present far from perfect, for the existence and the demands of individual mental differences in the general community have not hitherto been adequately recognized in our schemes of education. Yet who but the incompetent, who realizes that he has no right to his own social position, feels insecure in it, and wishes, therefore, to keep those born within a lower social stratum "in

their right place"—who else can doubt the ultimate value of systems of more widely-spread, better education, if only it be properly and variously adapted to the mental abilities of the recipients? Wild, ill-considered, revolutionary ideas must arise in the early phase of the education of any mass community—just as they arise during the youth of any individual of ability receiving the very best conceivable education. They are indicative merely of commencing thought and liberty of thought.

The present age is often designated as irreligious, but in reality there was never so much thought so widely given to religious problems as at the present day. What has diminished is only the servile, thoughtless adherence to long-accepted religious formulæ, dogmas and practices.

No, I firmly believe that in conduct, in sympathy for our fellows, in refinement, in self-control, in grade and independence of thought, and in ideas of social service we are as a community, as a civilization, definitely improving, despite certain set-backs which are, to my mind, merely of a temporary nature, comparable to the transitory, depressing effects of a medicinal remedy which ultimately leads to a vast improvement in physical health. One has also to take into account certain changes in fashion which, whether for the better or for the worse, are not essential or permanent features of our mental and moral progress. Further, we have to recognize that changes for the better can never be wholly free from accompanying changes in certain other directions for the worse. We have also to recognize that, deeply as we may regret the passing of certain attractive features

of by-gone days, we cannot reverse the march of events, any more than we can hope to give up machinery and revert to the hand-manufacture of articles which was only possible when our population was smaller and the masses of them had to be content with far fewer demands and with a far lower standard of living.

Never, as to-day, has each of us approached to so full a knowledge of himself and to so far better an appreciation of the standpoint, the ideas and the feelings of his fellows. The desire and the readiness for fighting between classes, between capital and labour, are perceptibly on the decrease, just as they are between at least the older European nations. Fighting is but the crudest, most primitive form of competition. The total abolition of competition, in its more advanced form at least, is at present unthinkable and undesirable. It is only wasteful, extravagant competition that needs to be suppressed and tends already to be disappearing, alike nationally and internationally by what is called industrial rationalization.

Must we infer physical and mental deterioration if, as individuals and as a nation, we abandon the more primitive forms of struggle for existence? If deterioration occurs in certain directions, are not improvements equally inevitable in others? And if, returning to our opening considerations, we ask how far these are real improvements in the nature of man, and how far they are due to the response of man to improvements in his environment, and would disappear if man were transplanted to a lower civilization—if, that is to say, we ask whether man has undergone

any intrinsic improvement, and if so in what directions and how far—we may, I think, indicate our general position in the following conclusions :—

(*a*) That in many respects we are vastly improving.

(*b*) That in many respects, perhaps in all respects within a particular race or people, these improvements do not arise broadly and directly from the fact that most members of that race or people are innately improving, but rather from the fact that the social heritage, the civilization into which they are born is improving.

(*c*) That the causes of improvement in the social heritage are ultimately due to improvements in a few "leading" individuals themselves for which their physical environment is, in part, responsible.

TRIGEMINAL NEURALGIA.*

BY

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MY excuse for bringing this subject before the meeting for discussion is that, although not a very common complaint, it is not exceedingly rare, and when it occurs treatment is a matter of urgency, and our ideas should be quite clear cut. Secondly, it has not been discussed in this Society in recent years. Thirdly, methods of treatment are by no means stereotyped; they differ considerably either in general principles or in detail, and it is worth while, therefore, to review the various procedures. However, before considering treatment we must consider diagnosis. Let us be quite sure as to the definition of the malady we are discussing.

Spasmodic trigeminal neuralgia, or tic douloureux, is a clear-cut clinical syndrome with certain well-known characters. There are conditions giving rise to pain in the region of the face; for instance, focal sepsis, etc., but they do not give rise to tic douloureux. The character of the pain is entirely different, and it would be a grave error in diagnosis to mistake the pain of, say, acute sinus disease, of alveolar abscess, or

* Communicated to the Bristol Medico-Chirurgical Society on 13th January, 1932.

glaucoma, for trigeminal neuralgia proper and act on the mistaken supposition.

The character of the pain in the cases I refer to should legitimately lead to a search for local sources of irritation; but if the history is one of typical spasmodic trigeminal neuralgia we shall always draw a blank, in fact we should expect to draw a blank.

What, then, are the characteristic features of tic douloureux? (1) The pain is of terrific intensity while it lasts; (2) it is intermittent, usually lasting a few seconds at a time; (3) it is lancinating or stabbing in character, never a dull, continuous boring pain; (4) it is always unilateral in any attack, though the opposite side of the face may be involved in subsequent attacks; (5) it is strictly limited in its anatomical distribution to trunks or twigs of the fifth nerve and never radiates beyond the field of this nerve; (6) it is never associated with focal disease; that is to say, focal disease does not produce the type of pain which we identify as tic douloureux.

Pathology.—What do we know of the pathology of the condition, and where is the lesion which gives rise to the pain? The answer to both questions is that we simply do not know. Because operations are devised to destroy the Gasserian ganglion in order to relieve pain, it is not unnatural that some should be prone to assume that the ganglion is the seat of disease; in other words, that we are dealing with a ganglionitis. I am not aware of the slightest evidence in support of such an assumption. I cannot conceive of a ganglionitis lasting for years. Such inflammation must necessarily be destructive, and the condition should cure itself

in time. Furthermore, when we do get indisputable evidence of a Gasserian ganglionitis, as for instance in herpes of the fifth nerve, the symptoms are not those of tic douloureux.

There is evidence that in certain cases of tic douloureux pathological changes may be present in the brain stem. We have a number of cases on record of spasmodic trigeminal neuralgia associated with disseminated sclerosis, cases in which there has been collateral evidence of plaques of insular sclerosis affecting the brain stem. In such cases we have impulses initiated in the field of first sensory neurone and conducted physiologically to the brain stem, there to become so altered that they are interpreted as agonizing pain. The problem is difficult to understand. Speculations on the subject are hardly profitable; they savour of arm-chair pathology, for trigeminal neuralgia does not supply post-mortem material. We come back, then, to the admission that we know little or nothing of the pathology of spasmodic trigeminal neuralgia. Having defined what we mean by spasmodic trigeminal neuralgia, we may pass on to consider the general principles of treatment.

The first outstanding fact which impresses me is the futility of medical treatment by drugs. Occasionally drugs are credited with affording some relief, but the position is unsatisfactory. Obviously it is possible to relieve some of the distress of individual attacks with potent sedatives or narcotics, but since the malady is characterized by long remissions it is always possible that a remission may follow the administration of almost any drug, and the last remedy to be used is prone to get undeserved credit. I am

not aware of any drug treatment which can be said to have produced a lasting cure.

Turning to surgical measures, we have to distinguish three broad lines of treatment: (1) open operation; (2) alcohol injections; (3) local avulsions. The technique of open operations has in recent years undergone a vast improvement. This improvement roughly dates from the time when Hutchinson began to practise partial gasserectomy, in which he removed the lower two-thirds of the ganglion, leaving the ophthalmic division intact. By this proceeding he greatly reduced the risk of injury to the cavernous sinus, for the ophthalmic division courses along within the wall of the sinus, and total extirpation of the ganglion cannot be carried out without the risk of very severe hæmorrhage and a consequent high mortality. Hutchinson's method also obviated the risks of neuroparalytic keratitis by sparing the first division of the fifth nerve. Fortunately the ophthalmic division is seldom primarily involved in tic douloureux. In this connection one may emphasize the importance of history taking. In the majority of cases careful inquiry will elicit the fact that the pain started in the second or third divisions, and only spread later to the first. In these cases it is sufficient to put the two lower divisions out of action to effect a cure. Consequently, Hutchinson's partial gasserectomy was generally successful, and in his hands enjoyed a low mortality.

A more recent surgical procedure is partial division of the sensory root behind the ganglion. In the hands of a certain few neurological surgeons, who have devoted much time and study to the details of the

operation, the latter method has proved very successful and the mortality is exceedingly low. One must remember, however, that the statistical results obtained by two or three surgeons with very special experience do not represent average results, and a good general surgeon can hardly expect to approach their figures with the limited material that must necessarily pass through his hands. The dissection necessary for the exposure of the sensory root is a difficult one, and is beset with dangers that can only be mitigated by wide experience.

The third surgical procedure of local avulsions, usually of the supra- or infra-orbital nerves, requires but brief consideration. Very seldom, if ever, has it proved successful. One is reminded of the common experience of surgeons of the futility of resecting alleged neuromata in amputation stumps. The usual clinical result of avulsions of peripheral branches of the fifth nerve is anæsthesia over the corresponding skin area, but with a persistence of the neuralgic pain. The procedure of local avulsion or peripheral nerve block betokens a lack of understanding of the physiological principles involved. If one may use a comparison, it may be said that the position of the sufferer from trigeminal neuralgia after a local avulsion is similar to that of a patient with a painful phantom limb after amputation.

We come now to a discussion of the alternative procedure, alcohol injection of the Gasserian ganglion, and we must try and form a true estimate of its value. Obviously it lacks the precision which attaches to the open operation in the hands of the experienced surgeon, but it seems that the questions we have to

decide are: (1) Is it an adequate procedure or does it present unavoidable pitfalls? (2) Are the results of injection within our control? (3) What advantages, if any, does it possess over the open operation? (4) How far does alcohol injection justify itself from the point of view of permanency of results?

Before describing the technique of alcohol injection and the relative merits of the various routes by which the ganglion may be approached, it will be an advantage to consider some points in the surgical anatomy of the Gasserian ganglion. The latter is situated in the middle fossa immediately above the foramen ovale, and is bounded on its inner side by the cavernous sinus. It is hemmed in above by tightly-stretched dura—an important point to remember, because the dura, together with the adjacent bone, forms a restricted space into which alcohol in small quantities may be injected under pressure. It is important for the success of the operation that this roof of dura should not be pierced by a needle. If it is, there is a danger of the alcohol travelling far and damaging neighbouring cranial nerves. A second point of importance is the short course of the third division of the fifth nerve as it leaves the ganglion to pass through the foramen ovale. So short is this course that the moment the needle enters the foramen it is practically within the ganglion itself, and an alcohol injection implanted at this point can be relied upon to perfuse the whole of the ganglion and even reach the sensory root on the proximal side of it.

The arrangement of the nerve fibres which constitute the sensory root and ganglion is worthy of notice. They pursue a parallel course on the proximal

side of the ganglion, and this parallelism is in the main observed right through into the three main divisions. This anatomical feature probably has an importance, making for the success of a well-placed alcohol injection. The path of least resistance for injected fluids will be interstitial and follow the course of the nerve fibres. It is highly probable, therefore, though of course difficult to prove by direct observation, that small quantities of alcohol slowly injected into the lower

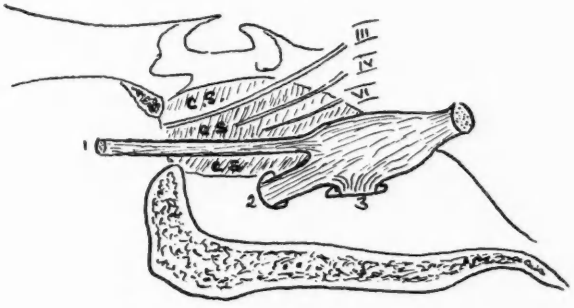

FIG. 1.

1, 2, 3.—The three divisions of the fifth nerve. Note the very short intracranial course of the third division.

C.S.—Wall of cavernous sinus.

III., IV., VI.—Cranial nerves running in the wall of the sinus, together with the ophthalmic division of the fifth nerve. Note the general parallelism of nerve fibres as they course through the Gasserian ganglion.

part of the ganglion will track backwards to the sensory root, so that a complete anæsthesia of the fifth nerve is achieved by blocking the sensory root behind the ganglion, and without complete destruction of all the cells belonging to the ophthalmic division of the nerve which are situated in the inner part of the ganglion. This probably accounts for the slightness of the danger of neuroparalytic keratitis after alcohol injection, if excessive quantities of alcohol are avoided

and if the injection is made very slowly. Usually as little as eight minims of alcohol is sufficient to produce complete anæsthesia. Other points in the topographical anatomy of the Gasserian ganglion can perhaps be dealt with when we come to the detailed technique of alcohol injection.

The technique for injection of the Gasserian ganglion.—I prefer the lateral mode of approach and technique instituted by Wilfred Harris. The necessary

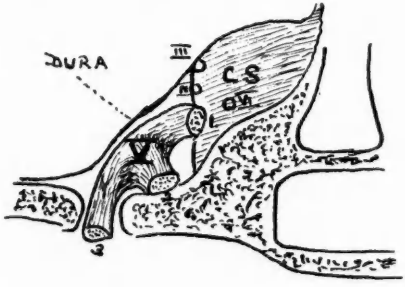

FIG. 2.

Note the confined space in which the Gasserian ganglion lies. Roofed in by dura, bounded on the inner side by the wall of the cavernous sinus, and bounded below by bone. The gap in the bony floor is the foramen ovale.

skin markings are: above, the slight concavity to be felt on the lower border of the zygoma immediately in front of the zygomatic tubercle; below, a line joining the incisuræ formed by the lobe of the ear with the cheek and by the alæ nasi with the upper lip. This line marks the lower limit of the sigmoid notch of the mandible. A vertical line is dropped from the zygomatic tubercle cutting the above base line; a second vertical line is drawn intersecting the base line a quarter of an inch in front of the former. The foramen ovale lies vertically deep to the zygomatic

tubercle, but normally it points slightly forwards and outwards. If, therefore, the needle is entered a quarter of an inch in front of this plane, and is passed through the sigmoid notch slightly upwards and backwards, it should reach the foramen at such an angle that the point of the needle can be insinuated through the opening.

The operation can be done quite satisfactorily,

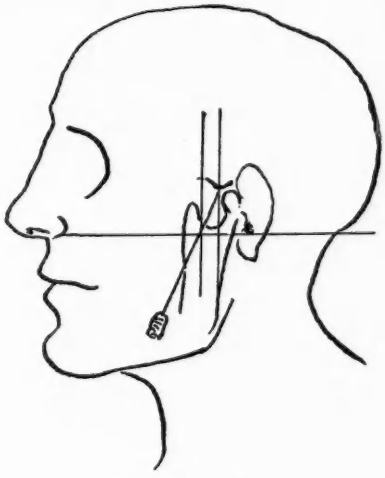

FIG. 3.

Surface markings for the lateral approach to the Gasserian ganglion through the sigmoid notch.

and without undue suffering, under novocain. A preliminary injection of morphia is often useful, but in my opinion a general anæsthetic in any form is bad practice and may be responsible for disaster. I prefer to use 4 per cent. novocain in order to reduce the amount of injection fluid to a minimum; at the same time, the skin, superficial tissues, and the region of the pterygoid muscles must be adequately

infiltrated. If this is not done the patient suffers unnecessary pain, which is liable to be misleading in a sensitive patient.

All procedures should be carried out slowly and with deliberation. It is wise in the first place to make the line of the puncture in a slightly forward direction ; thereby the point of the needle will come up against the external pterygoid plate of the sphenoid. This is the bony guide to the precise depth of the foramen ovale. It is well to measure accurately the length of needle lying outside the cheek at this point, for it affords useful information at a later stage if one is in doubt as to the depth at which one is searching for the foramen. Then withdraw the needle to the level of the sigmoid notch and push it inwards again, slightly upwards and backwards. At the previously ascertained depth the third division of the nerve will be encountered. If proper local anæsthesia has been employed all these manipulations are painless, but on striking the nerve there will be a sharp stab of pain. This can be allayed forthwith by injecting one or two drops of novocain. After allowing two or three minutes to elapse, test for anæsthesia in the field of the third division. If this is obtained, advance the needle about an eighth of an inch within the foramen. There will be a further manifestation of pain on the part of the patient ; once more inject a few drops of novocain, and after a suitable interval test once more for anæsthesia in the second and first divisions. At any time now corneal anæsthesia may develop. It should be remembered that the lower half of the cornea will become involved in an anæsthesia otherwise limited to the second division. If the first division is

picked off corneal anæsthesia becomes complete and is associated with loss of sensation in the supra-orbital region. Speaking generally, as soon as anæsthesia is obtained with novocain in the lower two divisions alcohol may be injected. This should be done very slowly drop by drop; under no circumstances should this stage of the operation be hurried. If by any mischance alcohol escapes beyond the confines of the ganglion into the intra-cranial space symptoms develop with dramatic suddenness, notably vertigo, nystagmus, and even vomiting, but no permanent harm is done if the rule to inject very slowly is observed.

The following difficulties may be encountered during the course of the operation. Occasionally the sigmoid notch is shallow, and it is difficult to manœuvre the needle over the edge of it. The employment of a dental prop usually enables one to obviate this difficulty. The internal maxillary artery may be wounded, in which case a hæmatoma may rapidly develop. Withdrawal of the needle and firm pressure for some minutes is usually effective, but if this minor accident happens the patient is liable some days later to develop discoloration over the cheek below the eye. If at any time during the operation blood regurgitates through the needle on removing the stilette withdraw the needle, completely wash it out, and start afresh, because blood mingled with alcohol forms a firm, impermeable clot, which prevents the injection of any fluid through the needle. Should the line of approach be misdirected in the backward direction the Eustachian tube may be wounded. The sign is pain referred to the depth of the ear. No harm is done if the needle is withdrawn before any fluid is

injected. A gross misjudgment of depth may result in a puncture of the pharynx. The sign is pain in the throat, and if novocain is injected it will be tasted by the patient. Location of the external pterygoid plate at an early stage in the operation should render this mistake quite avoidable. If the needle has entered the foramen ovale, and is advanced too far, the dura may be punctured and cerebro-spinal fluid may escape. In the face of such an accident I think the operation should be immediately suspended. Once the dura is punctured there is a real danger of leakage of alcohol to the base of the brain.

If the above rules are observed the operation of alcohol injection may be carried out with safety by the lateral route.

I do not employ Härtel's method, for the following reasons. The distance to the foramen is longer than by the lateral route and the bony landmarks are less easy to define. Assuming, however, that the needle enters the foramen, it is easy to pass it to an indefinite depth, and the danger of wounding the dura is great, also that of alcohol leakage beyond the confines of the ganglion is considerable. It has to be admitted, however, that Härtel's method has a number of advocates.

I do not propose to discuss injection of the second division in the sphenomaxillary fossa in any detail because I think the procedure has no merits. As an operation it is difficult. It can only institute a nerve block peripheral to the ganglion, the cells of which escape entirely. The operation, therefore, is never lasting as regards results, affording only temporary relief. The most cogent objection, however, is to be

found in the fact that alcohol is injected into loose tissues and can percolate widely—a different state of affairs from injection of alcohol into the confined space in which the ganglion itself lies, whereby alcohol diffusion is limited by tightly-stretched dura.

I have indicated the dangers which may arise from the diffusion of alcohol into surrounding tissues and the precautions whereby they may be avoided. The method of alcohol injection is, therefore, largely within the control of the operator. One minor mishap may occur occasionally and should be mentioned; fortunately it is not a serious one, as the effects are transient. The third and fourth nerves run in the wall of the cavernous sinus, and may be slightly affected by alcohol injected in their proximity. This may cause a slight temporary diplopia lasting, perhaps, a few days. The condition, however, soon rights itself.

Care of the eye after operation.—If, after the operation the patient retains a sense of deep pressure over the globe of the eye one need have little fear of any complications. However, in every case the eye should be covered with a shade as a protection from dust. Well-fitting goggles with side-pieces are adequate. No local applications of any kind should be used, but the patient should be instructed to report if there is the slightest appearance of redness about the conjunctiva. Should the latter appear, a well-fitting moist pad should be employed. In no case have I found it necessary to have the eyelids stitched. In fact, I have been pleasantly surprised at the infrequency of ocular complications after alcohol injections.

Permanency of results.—Obviously some injections are much more successfully implanted than others, but in those cases in which there is no material return of sensation a week after the injection of the ganglion one may presume destruction of ganglion cells, and cells so destroyed cannot regenerate. One's clinical experience goes to show that in a considerable proportion of cases results are permanent. It has to be admitted, however, that some cases require reinjection after one or two years, but in all such cases I have found there has been a partial return of sensation a short time after the original operation.

I wish to express my indebtedness to the writings of Dr. Wilfred Harris and Mr. G. Jefferson.

SOME OBSERVATIONS ON THE RELATIVE EFFICACY OF THE VARIOUS TREATMENTS OF PERNICIOUS ANÆMIA.*

BY

G. L. ORMEROD, M.A., M.B., B.Chir.

Historical.—Pernicious anæmia is a disease which has been known now for rather over a century. It was in 1822 that Dr. Combe, a Scottish physician, described a case which was undoubtedly one of pernicious anæmia, he being the first to differentiate between a special type of anæmia and the anæmias as a whole which had been known for ages past. From the autopsy he could find no cause for the condition, but thought that it was probably due to some disorder of the digestive system.

In 1849 Dr. Thomas Addison, of Guy's Hospital, described a disease like that reported by Combe, but laid more stress on there being no previous loss of blood from any cause whatever. He distinguished this anæmia from those due to some definite known cause by naming it idiopathic anæmia. It is this type of anæmia which now bears his name. He suggested that it might be caused by some form of fatty degeneration.

The next stage in the history of pernicious anæmia was in 1867, when Professor Biermer, of Zurich, described cases which were identical with those of Addison and Combe without knowing that they had

* From a thesis presented for the degree of M.B. Cantab.

previously been described. Biermer drew attention to the tendency towards capillary hæmorrhages, but so far no mention had been made of the important fact of remissions and relapses. As to the ætiology, Biermer's views differed from those of Addison on an important point, as he thought that the disease was simply a complication of symptoms, due to poor living and sepsis amongst other things. He also described the condition as occurring in cancer and *dibothriocephalus latus* infestation, and called the whole group of cases progressive pernicious anæmia, and included Addison's idiopathic anæmia as one of these. This view of the ætiology of the disease was taken up by the majority of the continental investigators, and there the condition is now commonly known as Biermer's anæmia.

Unfortunately, Addison's name in connection with the disease seems to have been forgotten, until in 1875 Dr. Pye-Smith, who was a pupil of Addison, pointed out that Addison was the first to describe the disease as a separate clinical entity, and this was acknowledged in 1878 by Professor Eichhorst when he wrote that "this disease was first described in England."

In the next twenty-five years William Hunter and Ehrlich were the chief contributors towards our knowledge of pernicious anæmia. In 1881 Ehrlich's discovery of the value of aniline dyes in staining blood films led to a great advance in the same cause.

Hunter realized that the disease involved not only the hæmatopoietic system, but also the alimentary and central nervous systems; thus he confirmed the original view of Combe seventy-five years previously. Hunter also strongly attacked Biermer's view of grouping various anæmias of different ætiology under

one heading, and firmly upheld Addison's view of its idiopathic nature. His chief work, though, was to do with sepsis of the whole alimentary tract, and he formed the opinion that the disease was due to a hæmolysis of the red-blood corpuscles in the portal system. He recognized, though, that this sepsis was not the actual cause of the disease, but that it paved the way for some hypothetical hæmolytic agent, the primary source of which he could not find.

Ehrlich, on the other hand, after the discovery by Pepper and Cohnheim in 1875 of the megaloblastic appearance of the bone marrow, stated that this condition was due to degeneration, and brought forward the view that this megaloblastic degeneration, as it was called, was the essential pathognomonic finding in pernicious anæmia. Later, Peabody investigated the bone marrow during life by puncture of the tibia, and discovered that the megaloblastic hyperplasia occurred during relapses, and during remissions the normoblasts were formed as usual.

In recent years the increased knowledge of the formation of the blood and of the reticulo-endothelial system, the discovery of the constant achlorhydria, and in particular Castle's work on the stomach, have all helped to shed further light on the ætiology of the disease.

Diagnosis.—The most common symptoms and signs in a case of pernicious anæmia are :—

(1) Anæmia with a relatively high hæmoglobin percentage, giving a colour index above 1·0.

(2) A blood film showing nucleated blood corpuscles, poikilocytosis, polychromasia with punctate basophilia and anisocytosis with the average size of the red cells increased to 8 or 9μ, which gives the high colour index.

(3) A slight hæmolytic jaundice which, together with the anæmia, gives the lemon-coloured tint to the patient.

(4) Achlorhydria.

(5) Glossitis (first described by Barclay in 1851).

(6) Remissions and relapses.

(7) The response to modern treatment. It has been said by several investigators that no improvement following upon liver or pig's stomach therapy indicates that the patient is not suffering from true pernicious anæmia.

Of these, the most important for a diagnosis of the disease are an increase in the average size of the red cells, the presence of megaloblasts in the blood, and the absence of free HCl in the gastric juice.

During the last eleven years experiments have been performed the results of which have completely altered the outlook and prognosis of pernicious anæmia. In 1920 Whipple and Robins performed experiments on dogs. From these animals they removed half their quantity of blood and then tried the effect of various types of diet on the time taken for the blood to return to its normal quantity. They found that a diet liberal in protein gave the quickest return to normal, but that whether it was derived from liver, heart or skeletal muscle made little difference. Two years later Jenks confirmed their findings.

In 1925 Whipple and Robins reported further experiments with dogs. This time they bled them repeatedly and so kept up a continuous severe anæmia. They kept the hæmoglobin percentage to a constant of 40—50, and by measuring the total amount of hæmoglobin in the blood which had to be withdrawn each time to do this they determined the rate of

blood regeneration. On trying the effect of various diets again they discovered that a diet rich in liver produced by far the most rapid hæmoglobin and red-blood corpuscle re-formation; next to this came kidney, then heart muscle and fourthly skeletal muscle. With regard to iron, they found that this was inert in the short anæmias but useful in the prolonged ones. Arsenic they found sometimes inert and sometimes it produced an improvement. They conclude their article by stating: "Under a variety of experimental conditions the reaction to iron and arsenic may vary, yet the favourable reaction to liver feeding is a sustained and uniform maximum."

Following on the work of Whipple and Robins, Minot and Murphy tried the effect of liver on pernicious anæmia. They thought that liver had its success by stimulating the maturation of the megaloblasts for three reasons: (1) there occurs a marked increase in the reticulocytes; (2) this increase is inversely proportional to the initial red-cell count, as there are few megaloblasts in the marrow when the count is relatively high than low; (3) in secondary anæmia the marrow does not contain so many megaloblasts, and liver does not increase the reticulocytes. White, of Washington, thought that the Kupffer cells may be responsible for the stimulus, as they probably belong to the same mesoblastic origin as the endothelial cells themselves, which when injected into a rabbit produce an overgrowth of the mesoblastic cells.

Shortly after the effectiveness of whole liver in the treatment of pernicious anæmia was discovered, Cohn made studies on the effective part of the liver and isolated an effective fraction of it which represents about 1 per cent. of the whole liver. It contains nitrogen, but is non-protein in nature; it is precipitated

by alcohol and is soluble in water. West also obtained an effective part. This extract is now marketed by several firms, and can be obtained as a liquid or a powder.

The next and latest advancement in the treatment of pernicious anæmia is the employment of hog's stomach. During the last few years much attention has been drawn to the constant symptom of achlorhydria. Castle followed this up in 1927 by a series of experiments. First he gave beefsteak to a patient with pernicious anæmia with no beneficial results. Then he gave artificial gastric juice—made from hydrochloric acid and pepsin—and still no improvement followed. Next he tried beef pre-digested with artificial gastric juice, with the same result. Finally he gave beefsteak to a normal person and allowed it to digest in his stomach for an hour; he then withdrew the chyme and gave it to a patient with pernicious anæmia; immediate improvement followed in the same way as with liver. It is thought from this that some substance is formed by the digestion of beef protein in a healthy stomach which is necessary for blood formation, and that it is stored in the liver chiefly and to a certain extent in the kidneys.

These experiments were followed up by trying the effect of normal stomach tissue on patients suffering from pernicious anæmia. The hog's stomach was used as it more closely simulates that of man than does any other animal. Desiccated preparations of the stomach were soon evolved, and are put up in the form of a powder.

The following cases of pernicious anæmia have been treated at the Bristol Royal Infirmary or General Hospital, and have been seen by the writer during the whole or part of their treatment.

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
C.B. 58 years. 17.4.26.	Anæmia.	Loss of weight and strength since December last. No appetite. Vomits. Sleeps well.	Pale yellow colour, gums and lips very blanched.	Tongue is smooth, moist and furred. Teeth, dentures. Spleen, not felt.	Normal.	R.B.C. 1,100,000. Hb. 25 per cent. Poikilocytosis, anisocytosis, few nucleated reds. V.D.B. 1·5 units indirect.	Blood transfusion. Liq. Arsenicalis m.3. Ac. HCl dil. ℥i-q.q.h. Kaolin ℥i b.d. 1.5.26. Transfusion.	2.5.26. R.B.C. 2,190,000. General condition better. 12.6.26. R.B.C. 2,900,000. Discharged and to continue treatment at home. 6.9.26. Readmitted very ill. Transfusion. 7.9.26. Dead.
A.B. 40 years. 16.4.26.	Anæmia and loss of appetite.	Been feeling ill for six months. Numbness in hands for three months.	Mucous membrane almost colourless.	Teeth, fair. Tongue, furred, smooth, shiny. Spleen, not felt. No free HCl.	Normal except for subjective reactions.	R.B.C. 1,400,000. Hb. 54 per cent. Size, 7·95μ. Polychromasia, poikilocytosis, anisocytosis. Nucleated reds.	Liq. Arsenicalis m.3 and HCl.	28.4.26. R.B.C. 1,900,000. 17.5.26. Still improving and to continue treatment at home. May, 1931. Been on liver extract for last three years and her present condition is good.

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
A.J. 45 years. 18.1.27.	General weakness.	Started six months ago. Diarrhœa and pins and needles in legs for last three months.	Typical yellow colour.	Spleen, just felt. No free HCl.	No change.	R.B.C. 1,250,000. Hb. 30 per cent. C.I. 1·3. W.B.C. 6,000. Poikilocytosis, anisocytosis.	Liq. Arsenicalis HCl dil. m.20 t.d.s.	3.2.27. R.B.C. 2,000,000. Hb. 40 per cent. C.I. 1·1. 17.2.27. R.B.C. 2,300,000. Hb. 40 per cent. C.I. 0·95. 1.3.27. R.B.C. 2,750,000. 7.3.27. R.B.C. 3,100,000. Hb. 45 per cent. Still has tingling in legs, but feels much better. Discharged to continue treatment. Died a few weeks later
S.P. 48 years. 18.5.27.	General weakness. Cough.	Has been getting short of breath for last year. Very sore tongue for last month.	Pale colour. Dulness and crepitations at left apex.	Superficial glossitis. Spleen felt. No free HCl.	No change.	R.B.C. 2,800,000. Hb. 55 per cent. C.I. 1·1. W.B.C. 9,000. Poikilocytosis. Nucleated reds.	Liq. Arsenicalis m. 3 t.d.s. increased gradually to m. 10 t.d.s. 10.6.27. Injections of Arsenious Acid gr. 1/20 twice a week. 6.6.27. Transfusion. 20.6.27. Transfusion.	1.6.27. R.B.C. 2,400,000. General condition worse. 20.6.27. R.B.C. 2,500,000. 1.7.27. R.B.C. 1,700,000. 6.6.27. General condition very bad. 10.6.27. Improved. 20.6.27. Worse again. R.B.C. 1,200,000. Hb. 20 per cent. 22.6.27. Died. P.M., signs of pernicious anæmia and cavities in both lung apices.
B.S.	Anæmia	Started	Very thin	Spleen, not felt.	Vibration	R.B.C. 1,600,000.	Arsenious	5.6.27.

								22.6.27. Died. P.M., signs of pernicious anæmia and cavities in both lung apices.
B.S. 34 years. 28.5.27.	Anæmia and weakness.	Started three months ago losing weight. Insomnia.	Very thin and anæmic.	Spleen, not felt. No free HCl.	Vibration sense in legs poor. Legs spastic. Plantar reflex.	R.B.C. 1,600,000. Hb. 45 per cent. C.I. 1·5. Average diam. 7·9μ (4μ to 11μ). W.B.C. 5,310. Poikilocytosis, polychromasia, punctate basophilia. V.D.B. reaction 2·5 units indirect.	Arsenious acid injections, HCl.	5.6.27. R.B.C. 1,900,000. 27.6.27. R.B.C. 2,260,0000. 13.7.27. R.B.C. 3,670,000. Hb. 70 per cent. Discharged on same treatment. April, 1931. Has been on liver extract and HCl for last two years and feels very well. R.B.C. 4,150,000. Slight variation in size and shape.
M.G. 47 years. 18.4.27.	Feeling tired.	Has had several attacks of anæmia which improved on taking Blaud's pills; has been worse the last few months. Tongue sore for six months.	Sallow complexion.	Teeth good. Tongue red and raw. Spleen, slightly enlarged. No free HCl.	Normal.	R.B.C. 2,500,000. Hb. 55 per cent. C.I. 1·1. Great variation in size and shape. Few nucleated red cells.	Liq. Arsenicalis m. 3 t.d.s. up to m. 10 t.d.s., HCl dil. 28th June. Raw liver, but could not take it. Then cooked liver. Feb., 1928. Taking 1 lb. cooked liver a day and HCl. April, 1931. ½-lb. cooked liver and ½-lb. kidneys a week.	7.5.27. R.B.C. 2,800,000. 15.5.27. Feels much better. Spleen smaller. 28.5.27. Feels very well. R.B.C. 3,950,000. Hb. 80 per cent. C.I. 1·0. Still slight variation in size and shape. Discharged on Arsenic and HCl. October, 1927. Relapsed. February, 1928. Good response. R.B.C. 3,000,000. Good appetite. April, 1931. Feels very well. At one time tried liver extract, but found she was better with fresh liver.

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
G.B. 46 years. 2.5.27.	Great weakness. Vomiting.	Started a year ago ; been worse since confinement six months ago.	Typical lemon colour.	Teeth very bad. Spleen, not felt.	Knee-jerks nil. Plantar reflex flexor. Sensation poor in both legs.	R.B.C. 920,000. Hb. 25 per cent. C.I. 1·25. W.B.C. 6,900. Poikilocytosis, anisocytosis. Nucleated reds.	Liq. Ferri. Perchlor, m.7. Liq. Arsen. Liq. Strych. Hyd. m. 3 t.d.s. HCl dil. m. 30. 19.5.27. Off arsenic. 30.5.27. On arsenic again.	15.5.27. No better. 19.5.27. Diarrhœa. R.B.C. 1,000,000. 30.5.27. Improving. R.B.C. 1,250,000. 7.6.26. 7.6.27. Went home. April, 1931. Not heard of again.
A.E. 54 years. 30.4.28.	Weakness and paleness.	Started eighteen months ago. Vomits much.	Very anæmic.	Tongue, raw and red. Teeth, poor. Spleen, not felt.	Normal.	R.B.C. 1,800,000. Hb. 5 per cent. Poikilocytosis, anisocytosis. Nucleated reds.	Liver extract ʒii t.d.s. HCl dil. m. 30. Liq. Arsenicalis m. 4 t.d.s. Teeth extracted.	8.5.28. R.B.C. 2,600,000. Hb. 60 per cent. 18.5.28. R.B.C. 3,400,000. Hb. 70 per cent. 1.6.28. R.B.C. 3,900,000. Hb. 20 per cent. 12.6.28. R.B.C. 4,100,000. Hb. 70 per cent. 4.7.28. Feels very well. R.B.C. 4,200,000. Hb. 75 per cent. Discharged. To continue treatment at home. May, 1931. Still well; taking liver and liver extract.

								Still well; taking liver and liver extract.
O.C. 49 years. 17.4.30.	Anæmia.	Feeling weak for last six months. Appetite poor. Numbness and tingling in legs.	Thin and pale.	Teeth, fair. No free HCl. Spleen, not felt.	Poor vibration sense, otherwise normal.	R.B.C. 2,400,000. Hb. 55 per cent. C.I. 1·1. Variation in size and shape. Several poorly staining cells. No nucleated red cells seen.	½-lb. lightly cooked liver daily. 3.6.30. To take liver extract ℥i t.d.s. and HCl m. 30 t.d.s.	7.5.30. R.B.C. 3,000,000. Hb. 65 per cent. 18.5.30. Hb. 65 per cent. 27.5.30. Has severe cold and is not so well. R.B.C. 4,300,000. Hb. 65 per cent. 3.6.30. Much better. Discharged. May, 1931. Still on liver, but given up extract. HCl. Feels fairly well, but gets giddy at times. Occasionally gets tingling in legs. R.B.C. 4,100,000. Hb. 70 per cent. Anisocytosis. No nucleated reds. B.P. 164/110 C.N.S. normal. February, 1932. Feels very well, and still on liver extract.

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
A.C. 62 years. 11.10.30.	Anæmia and dyspepsia.	Been getting bad for two years, but much worse last two months.	Very thin and anæmic.	Teeth, dentures. Spleen enlarged. No free HCl.	Normal.	R.B.C. 1,000,000. Hb. 23 per cent. C.I. 1·1. Much poikilocytosis anisocytosis and nucleation of red cells.	18.10.30. Liver 6 oz. and liver extract on alternate days. 1.11.30. Is having liver every day instead of extract.	18.10.30. Weaker and lost 4 lbs. in weight. R.B.C. 900,000. 25.10.30. R.B.C. 1,250,000. Hb. 30 per cent. Reticulocytes 15 per cent. 1.11.20. R.B.C. 2,000,000. Hb. 40 per cent. Reticulocytes 12 per cent. 8.11.30. General condition very much better. R.B.C. 3,000,000. Hb. 65 per cent. 23.11.30. Has gained 15 lbs. since admission. R.B.C. 4,200,000. Hb. 75 per cent. Still some poikilocytosis and anisocytosis. No reticulocytes seen. Discharged.

L.P. 65 years. 9.11.30.	Weakness, insomnia, frequency of micturition.	Getting bad for six months.	Very pale and thin.	Teeth, dentures. Spleen, not felt.	Marked mental changes. Knee-jerks absent. Plantar reflexes extensor. Incontinence of urine and fæces. Sensation poor in all limbs.	R.B.C. 1,260,000. Hb. 25 per cent. Much variation in size and shape. Several megaloblasts.	Cooked liver but cannot take it. 11.11.30. Liver extract 3i t.d.s.	11.11.30. Much vomiting. 13.11.30. Unconscious all day. 14.11.30. Died. P.M. Typical changes of pernicious anæmia.
L.E. 55 years. 8.1.31.	Loss of use of legs.	Numbness in toes started two years ago and gradually lost power of legs. Appetite poor. Much vomiting. Always been anæmic.	Thin and pale. One breast removed fifteen years ago.	Tongue, smooth and red. Spleen, not felt. No free HCl.	Knee-jerks, absent. Plantar reflexes flexor. Sensation poor.	R.B.C. 1,240,000. Hb. 50 per cent. Poikilocytosis, anisocytosis, megaloblasts.	Liver extract 3i t.d.s.	11.1.31. Cannot pass water. Delirious. R.B.C. 1,200,000. Hb. 40 per cent. 18.1.31. Died. P.M. Changes of pernicious anæmia also cystitis and pyelonephritis.

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
T.C. 38 years. 21.1.31.	Numbness in hands and feet for four months. Palpitations. Sore tongue, getting yellow.	—	Yellow colour.	Teeth, dentures. Tongue, pale and smooth. Spleen, not felt. No free HCl.	All reflexes brisk, otherwise normal.	R.B.C. 2,600,000. Hb. 70 per cent. Poikilocytosis, anisocytosis, polychromasia, punctate basophylia megaloblasts. V.D.B. indirect 4 units.	11.2.31. Cooked liver and kidneys. Liq. Arsenicalis m. 8, Ac. HCl dil. m. 45 t.d.s. 28.2.31. ½-lb. liver a day only. May, 1931. Is having liver extract, cooked liver and HCl.	11.2.31. Condition about the same. 20.2.31. Improved. R.B.C. 2,900,000. Hb. 75 per cent. 28.2.31. R.B.C. 3,300,000. Hb. 75 per cent. Jaundice gone. 14.3.31. R.B.C. 4,200,000. Hb. 80 per cent. Slight variation in size and shape of red cells. numbness disappeared. Discharged. May, 1931. Still very well. R.B.C. 4,500,000. Hb. 80 per cent.

B.S. 56 years. 17.7.30.	General weakness.	Very well until three months ago, when he had pains over heart and tingling in left hand. Indigestion.	Lemon colour. Systolic murmur over whole of præcordium	Teeth, false. Tongue, furred. Spleen, just felt. No free HCl.	Subjective sensations only.	R.B.C. 1,100,000. Hb. 45 per cent. Poikilocytosis, anisocytosis, punctate basophylia, nucleated red cells. V.D.B. 1 unit indirect.	Ventriculin 10 gms. b.d. (1 gm. Ventriculin = 12 gms. whole stomach.) 26.9.30. Ventriculin 10 gms. daily.	24.7.30. Improved generally. R.B.C. 1,600,000. 3.8.30. No indigestion. R.B.C. 2,700,000. Hb. 50 per cent. 19.8.30. R.B.C. 3,100,000. Hb. 60 per cent. 3.9.30. Feels very well. R.B.C. 4,000,000. Hb. 65 per cent. Variation in size and shape, but no nucleated red cells. Discharged. To continue with 10 gms. Ventriculin a day. November, 1930. Died. Had not been taking Ventriculin regularly.

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
J.T. 50 years. 29.9.30.	Sent in by a cottage hospital for splenomegaly.	Aching pain in left side for six months. Appetite poor. Vomiting and diarrhœa. Tingling in legs and too weak to walk for the last three weeks. Sore tongue.	Considerably jaundiced. Mucous membranes pale.	Teeth, very poor. Tongue, marked superficial glossitis. No free HCl. Spleen, reached nearly to the umbilicus.	Knee-jerks, left absent, Plantar reflex, left extensor. Poor sensation in both legs.	R.B.C. 1,900,000. Hb. 50 per cent. C.I. 1·3. Marked poikilocytosis, anisocytosis with megaloblasts, punctate basophilia. V.D.B. 7·5 units indirect.	Ventriculin gm. 10 b.d. Teeth extracted two by two.	4.10.30. Feels better and appetite has improved. R.B.C. 2,000,000. Hb. 50 per cent. Reticulocytes 5 per cent. 10.10.30. Diarrhœa hasstopped. R.B.C. 2,800,000. Hb. 55 per cent. Reticulocytes 18 per cent. 17.10.30. Jaundice practically gone. Tongue quite better. R.B.C. 3,900,000. Hb. 65 per cent. Reticulocytes 6 per cent. 25.10.30. General condition very much better. Has a very high colour. R.B.C. 4,900,000. Hb. 90 per cent. Reticulocytes 2 per cent.

Still well, but still slight pins and needles in feet. Reflexes as before.

								cent.
								Still well, but still slight pins and needles in feet. Reflexes as before. Spleen much smaller. R.B.C. 5,000,000. Hb. 90 per cent.
							8.11.30. Ventriculin 10 gms. a day.	8.11.30. R.B.C. 5,200,000. Hb. 90 per cent.
								20.11.30. Still well.
								1.12.30. R.B.C. 5,100,000. Hb. 85 per cent. Spleen cannot be felt. Still tingling in feet.
							20.12.30. Ventriculin 10 gms. b.d.	20.12.30. Not so well. R.B.C. 3,600,000. Hb. 55 per cent.
								5.1.31. Improving.
								10.1.31. R.B.C. 4,000,000. Hb. 75 per cent.
								20.1.31. Feels quite well again R.B.C. 5,300,000. Hb. 100 per cent. Spleen not felt ; still tingling in legs ; reflexes as before. Discharged.
								April, 1931. Feels very well, but still has tingling in feet. Has given up Ventriculin for last month and been having 3 lbs. liver a week.

Name. Age, Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
E.N. 48 years. 15.12.30.	Tingling in arms and legs. Anæmia.	Has been feeling run down for a year. Tingling for three months. Appetite very poor. Much diarrhœa.	Rather pale.	Teeth, dentures. Spleen, not felt. No free HCl.	Much diminished sensation in all limbs. Reflexes normal.	R.B.C. 2,600,000. Hb. 65 per cent. Poikilocytosis, anisocytosis, megaloblasts.	Ventriculin gms. 10 b.d. 22.12.30. Ac HCl. dil. m 30 t.d.s. added. 20.1.31. Going to have ½-lb. liver six days a week together with HCl and iron.	22.12.30. Appetite still very bad and much vomiting. 27.12.30. Feels much better and can eat. Still tingling. R.B.C. 3,000,000. Reticulocytes 4 per cent. 1.1.31. R.B.C. 3,200,000. Hb. 70 per cent. Reticulocytes 4 per cent. 8.1.31. Very much better and eats well. R.B.C. 4,000,000. No reticulocytes seen 20.1.31. Still much improving and tingling less. R.B.C. 4,500,000. Hb. 80 per cent. Slight variation in size and shape. No nucleated red cells. Discharged. April, 1931. Still very well.
		Started three	Rather	Teeth, dentures.	Sensation	R.B.C. 2,720,000. Hb. 50 per cent.	Liver 6 oz. daily.	3.2.31. Condition about the

								April, 1931. Still very well.
E.F. 37 years. 23.1.31.	Inability to walk, with tingling in arms and legs. Shortness of breath. Flatulence.	Started three months ago.	Rather anæmic and thin.	Teeth, dentures. Spleen, not felt.	Sensation diminished in forearms and legs. Knee-jerks, both increased. Left extensor, plantar reflex. No clonus. Abdominal reflex, absent.	R.B.C. 2,720,000. Hb. 50 per cent. C.I. 0·95. Poikilocytosis, anisocytosis. Nucleated red cells.	Liver 6 oz. daily. HCl, m. 20 t.d.s. 3.2.31. Liver extract ʒii t.d.s. instead of liver. 20.2.31. Off liver extract and put on Ventriculin 10 gms. b.d. 22.3.31. Extomak 2 phials a day instead of Ventriculin.	3.2.31. Condition about the same; can't take the liver. 10.2.31. Slight general improvement, but very poor appetite. R.B.C. 2,900,000. Hb. 50 per cent. Reticulocytes 2 per cent. 20.2.31. Still about the same. Much troubled by tingling 24.2.31. Feels definitely better 28.2.31. Colour much better. Tingling lessened. Appetite improved. R.B.C. 3,270,000. Hb. 50 per cent. Reticulocytes 2½ per cent. 14.3.31. A good deal better. R.B.C. 3,800,000. Hb. 60 per cent. 22.3.31. Still improving. 4.4.31. Very much better. Tingling nearly gone. Reflexes as before. R.B.C. 4,570,000. Hb. 65 per cent. Slight variation in size and shape. 28.4.31. Eating very well; still slight tingling. Discharged. To continue same treatment

Name. Age. Admitted.	Complaint.	History of present illness.	General condition.	Alimentary system.	C.N.S.	Blood.	Treatment.	Progress.
E.C. 51 years. 18.3.31.	Shortness of breath and tiredness.	—	Very anæmic.	Teeth, false. No glossitis. Spleen, not felt. No free HCl.	Subjective sensations only.	R.B.C. 2,520,000. Hb. 60 per cent. Poikilocytosis, anisocytosis. No nucleated red cells seen.	Extomak 2 phials daily.	26.3.31. Feels much better. R.B.C. 3,300,000. Hb. 65 per cent. 1.4.31. R.B.C. 3,600,000. 10.4.31. R.B.C. 4,800,000. Hb. 75 per cent. 18.4.31. R.B.C. 5,260,000. Hb. 85 per cent. Still slight poikilocytosis and anisocytosis. General condition very good. Discharged. May, 1931. Feels and looks well. Been having ½-lb. lightly cooked liver a day. R.B.C. 4,900,000.
M.G. 35 years. 30.1.31.	Has been getting very weak for the last year, since confinement. Diarrhœa. Vomiting.	—	—	Tongue, normal. Teeth, false. Spleen, not felt.	Knee-jerks brisk. No clonus. Plantar reflex doubtful.	R.B.C. 1,900,000. Hb. 45 per cent. C.I. 1·1. Anisocytosis, poikilocytosis, polychromasia. Nucleated cells.	½-lb. raw hog's stomach daily, HCl. m. 30 t.d.s. 5.2.31. Gastrex instead of raw stomach.	10.2.31. Decided improvement all round. R.B.C. 2,125,000. Hb. 45 per cent. Reticulocytes 5 per cent. 17.2.31. R.B.C. 2,950,000. Hb. 50 per cent. Reticulocytes 4 per cent. 3.3.31. Very much better and no bad symptoms. R.B.C. 4,500,000. Hb. 55 per cent. Discharged.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	May, 1931. Been continuing with

								and no bad symptoms. R.B.C. 4,500,000. Hb. 55 per cent. Discharged.
								May, 1931. Been continuing with stomach preparation since discharge. Well up to a fortnight ago, but since then has not felt at all well, but not as bad as before going to hospital. Gets pins and needles in arms and legs. Tongue sore. Anæmic and jaundiced. R.B.C. 2,100,000. Hb. 40 per cent.
F.S. 52 years. 26.1.31.	General weakness.	No energy for four months. Appetite bad. Pneumonia four years ago, and never been the same since.	Pale lemon colour. Teeth, dentures.	Superficial glossitis. Spleen, enlarged. No free HCl.	No change.	R.B.C. 1,980,000. Hb. 35 per cent. C.I. 1·0. Poikilocytosis, anisocytosis, polychromasia. Punctate basophilia, megaloblasts.	Liver extract ʒii t.d.s. HCl.	5.2.31. Appetite better. 9.2.31. R.B.C. 2,900,000. Hb. 45 per cent. 20.2.31. R.B.C. 3,930,000. Hb. 60 per cent. Anisocytosis, poikilocytosis. Jaundice gone. Tongue better. 5.3.31. Feels very well. R.B.C. 5,200,000. Hb. 70 per cent. Discharged. May, 1931. Has been on same treatment since discharge. Does not feel as well as a month ago and easily gets tired. R.B.C. 3,500,000. Hb. 60 per cent.

Summary and Conclusions :—

Arsenic.—Up till four or five years ago this was by far the best method of treating the disease. Even with its use the average duration of life from the start of symptoms was only six months to two years, and only two cases of cure have been reported on it. With its use during the best remissions the red corpuscles rarely rose higher than 3,000,000 per c.mm.

Iron.—This is of no use by itself, but is useful in conjunction with other treatments ; it is a producer of hæmoglobin rather than a stimulating agent to the formation of red-blood corpuscles.

Operative Methods.—The only two procedures which are of use are (*a*) transfusion and (*b*) removal of easily accessible septic foci. The former is only useful in tiding over a critical time, and for the latter the removal of septic teeth is a great adjunct to treatment. In Percy's procedure of removing the gall-bladder, appendix and spleen it appears to have been the splenectomy which was the important part, as those patients who did not have this organ removed did not do as well as those who did. On the whole, though, splenectomy is not worth performing.

Hydrochloric Acid. — This will not cure the achlorhydria, but in small doses is sometimes useful as a gastric stimulant, and thus has an indirect therapeutic use by enabling the patients to take their liver or stomach foods more readily.

Liver.—This was an immense advance on anything which had as yet been tried in the treatment of pernicious anæmia. The following are the chief points in its use :—

(*a*) From half to a quarter of a pound at least should be taken daily.

(*b*) It has its maximum effect when taken raw, but may be lightly cooked in any way desired.

(*c*) An increase in the reticulocytes occurs. Normally this is from ½ to 2 per cent., but during liver treatment they rise to 10 to 15 per cent., and are at their maximum about the end of the first week, and then gradually fall, reaching their normal number during the third week.

(*d*) The lower the initial red-blood count the higher is the reticulocyte peak. A low reticulocyte count with a low initial red count indicates a bad prognosis or insufficient liver.

(*e*) On full doses of liver the red-blood corpuscles eventually reach 4 to 4½ million, and occasionally over 5 millions.

(*f*) The patients' colour is no indication of their true red-blood count, which is often lower than their appearance suggests.

(*g*) An improvement in the appetite, a pink flush over the malar bones and subsidence of the diarrhœa are often the first signs of improvement, and occur usually between the fourth and seventh day.

(*h*) An increase in the red-blood cells is apparent on the fifth or sixth day, and is preceded by increased reticulocytes.

(*i*) The soreness of the tongue is soon diminished.

(*j*) The jaundice rapidly fades, and the Van den Bergh test is usually normal in a fortnight.

(*k*) The nervous symptoms are the last to improve. Only the subjective signs usually improve, but definite organic changes remain the same, although two cases of a reversion to a flexor plantar reflex have been recorded at Newcastle.

(*l*) Hydrochloric acid makes no difference to the majority of patients, but is beneficial to some.

(*m*) Free hydrochloric acid practically never returns to the stomach.

(*n*) Any superimposed infection, however slight, diminishes the effectiveness of the treatment.

(*o*) Although the patient may at first dislike liver, he often gets a craving for it when he has started to improve.

(*p*) The larger the amount taken the more rapid is the reticulocyte response. Occasional massive doses may be given instead of repeated small ones; it is the total amount of liver taken that matters, not the daily dose.

(*q*) The discovery of the effective fraction of the liver was a great advance, as it is easy to take, whereas many people cannot take whole liver.

(*r*) When liver extract is being used it has to be given in slightly larger doses than its equivalent of whole liver.

(*s*) It has been found in several cases that previous transfusion detracts from the efficiency of liver.

(*t*) There have been a very few instances of gout and venous thrombosis ensuing after liver treatment, but these can be eliminated by using the extract.

(*u*) In the years 1921–26 the mortality from pernicious anæmia was unchanged; in 1927 and still more in 1928 there was a definite reduction in mortality from pernicious anæmia, there being 915 less deaths from this disease than was expected. The improvement was greatest in London and least in the small urban districts. All this is what one would have expected from an increasing use of a new beneficial treatment.

(*v*) It has been said by many that if there is no improvement on liver either not enough liver is being taken or the case is not one of pernicious anæmia.

Hog's Stomach.—Up to the present time by far the best results have been achieved by the use of this. By the regular use of this it may be said that pernicious anæmia is a definitely curable disease. Whereas the use of liver merely supplies the patient with the ready-made substance that is essential for the formation of the red cells, the use of stomach tissue supplies them with that which is wanted to enable them to make their own red-blood cell formative material.

(*a*) The remissions that take place after the use of this are of the same nature as those caused by liver, but occur more rapidly. Reticulocyte crises after stomach tissue often reach from 20 to 40 per cent. when the substance is given in sufficient doses; at Bristol, though, the highest recorded is only 16 per cent., but in no case where stomach has been used has the initial red count been below 1,500,000, and more than equivalent of 240 gms. a day have been used.

(*b*) The addition of hydrochloric acid is much more rarely needed when stomach is used than when liver is the treatment.

(*c*) Very few deaths have been recorded in those taking the treatment, and in nearly every case it was found that the stomach extract was not being taken regularly. Wilkinson reports that of 108 cases 92·7 per cent. after eighteen months are quite free from symptoms, and a further 6 per cent. have nerve trouble but are otherwise well.

(*d*) Previous blood transfusions appear to make no difference to the result.

(*e*) Several cases which have failed to respond to liver in adequate amounts have immediately improved on starting to take hog's stomach, either raw or as a desiccated preparation.

(*f*) If it can only doubtfully be said that absence

of improvement with liver indicates that the disease is not pernicious anæmia, it can certainly be said so of hog's stomach.

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Reviews of Books

Health and Hygiene in England from Roman to Victorian Times. By J. A. DELMEGE, O.B.E., M.R.C.S. Pp. xiv., 234. Illustrated. London: William Heinemann Ltd. 1931. Price 21s.—This book gives a brief but most interesting history of the changes in public health and of the growth of the hygienic art in this country for 1,800 years. The story of the epidemics here, and of the food, housing, clothing, and the industrial conditions of the people at different epochs is a marvel of good condensation and, indeed, of accuracy, when we consider the vast accumulation of facts here collected, though, of course, there is room for divergent opinions as to the inferences to be drawn from some of them. It is intended chiefly for the lay reader, and, as Sir Thomas Legge in a foreword says, it "can be read with pleasure and unfailing interest from end to end by everyone." Yet the medical scientist, too, cannot fail to find much of value in these records of the course of disease in the past. Thus, to take an instance, we learn some of the causes of the huge mortality of infants in former times. Besides the absence of air, light, and warmth in the houses are, for those who could not be breast fed, the absence of any pure cows' milk or infants' food, and the constant presence of infectious fevers of various kinds and overcrowding in the towns. This is worked out in detail with illustrative facts. The great work of Howard, Chadwick, Shaftesbury, Owen and Nightingale fill many delightful pages. We think it might be made clear that most almshouses, unlike the hospitals, survived the Dissolution under the Tudors, and we suggest that very few poorhouses under the Act of Elizabeth were set up till Carey's Act of 1696 allowed parishes to form Unions. In the next forty years no less than 115 were set up and the progress went on steadily. The book is beautifully printed and illustrated, but the paper is very heavy for a book of this size.

Sixty Centuries of Health and Physick. By S. G. B. STUBBS and E. W. BLIGH. Pp. xvi., 253. Illustrated. London: Sampson Low, Marston & Co. Ltd. Price 15s.—In his Introduction to this history of medicine Sir Humphry Rolleston has summarized its point of view by the remark: "In tracing

the evolution of 'physick' from primitive magic to modern medicine the authors have successfully brought out the importance of the preventive idea which should permeate the teaching, practice and research of the medicine of the future." The authors have indeed achieved a notable success in tracing out the progress of ideas rather than cataloguing the biographies of individual scientists and collecting historical incidents. Their method has been "to seize the prevalent ideas of each age of medicine," so as to give the reader a clear conception of the growth of medical science and particularly of hygiene. The result of their labours enables them to present a continuous story of surpassing interest, documented by numerous quotations from out-of-the-way sources and aptly furnished with beautiful illustrations.

A Theory of the Formation of Animals. By W. T. HILLIER, M.R.C.S. Pp. viii., 166. Illustrated. Bristol: John Wright & Sons Ltd. 1932. Price 8s. 6d.—This book, attractive in style and in title, presents a theory of the dual in our constitution. Dr. Hillier takes the blastula for the type of all metazoa; antecedent to the conjugation of ovum and sperm have been the collision and collusion of blastula-like organisms. These are dissevered in the gastrula so that the cellular descents from each are thenceforward separate. Serial and segmented organs mark the intercalation of asexual phases of growth. Cells find their place in the body's finished symmetry, under the dominance of an "active meridian." For proof the author goes to Polygordius, a minute annelid of German seas, within whose primitive lines can be easily traced the tendencies of growth in embryo. The argument is carried to vertebrates in an elaborate study of the anatomy of the herring, bony homologies of which are brought out in some beautiful illustrations.

Modern Medical Treatment. 2 volumes. By E. BELLINGHAM-SMITH, M.D., F.R.C.P., and A. FEILING, M.D., F.R.C.P. Pp. xvii., 701; vii., 705. London: Cassell & Co. Ltd. 1931. Price 30s.—We should expect this work to attain a very high standard, and we are certainly not disappointed. There is here no mere statement of numerous therapeutic methods which have been copied from one book to another to such an extent that the reader turns wearily to some foreign work for further information. On the contrary, every section of the book, without exception, is so well written, so well balanced, so free from fad, and so modern in outlook,

that we are bound to feel that it must supply a much-felt want. At the commencement of each chapter the rationale of treatment is outlined. From the point of view of the student, this must form one of the most valuable features of the book. Further, where necessary the writers have not failed to indicate the various ætiological factors upon which the method of treatment depends. Thus they state that "it is unfortunate that the term sciatica has been used loosely to designate almost any kind of pain in the buttock, hip or thigh." They then proceed to discuss the various causes of sciatic pain, and show clearly how treatment must depend upon the diagnosis. Again, to physician and surgeon alike, might be commended the measured discussion on hyperthyroidism, Graves's disease and toxic goitre. It is to be regretted, however, that the treatment of the latter condition is not really outlined. It is difficult to criticize a work of such uniform excellence. A few suggestions, however, may not be untoward. Thrombosis of the coronary arteries is surely worthy of more discussion? Again, in considering the treatment of arthritis associated with chronic infection of the prostate no mention is made of the application of diathermy to the focus of infection. Recurrent aphthæ in the mouth may be very difficult to treat, and it is well that this affection is briefly considered, though it is to be regretted that no mention is made of a treatment which is of real value, namely the application of colloidal mercurochrome. Finally, scarlatinal antitoxin would be a better phrase than "antiscarlatinal antitoxin." These and others, however, are minor details which detract but little from a work which may be said to be a worthy product of the London schools of medicine.

The Thyroid and Manganese Treatment. By H. W. NOTT, M.R.C.S. Pp. xv., 265. London: William Heinemann Ltd. 1931. Price 7s. 6d.—In this volume the author describes in detail the steps by which he was led to regard the "Thyroid and Manganese Treatment" as a cure for the majority of diseases. The treatment consists of the administration of thyroid extract by mouth, together with rectal injections of a solution of potassium permanganate. In certain cases, instead of the rectal injection, potassium permanganate may be given orally in a cachet, but as a rule the results are not nearly so satisfactory. It is claimed that this treatment will cure all acute infections, including pneumonia and meningococcal meningitis, and such diverse diseases as diabetes mellitus,

gastric ulcer, toxæmias of pregnancy, and varicose ulcers, to mention only a few. Most of the diseases met with in general practice tend to improve whatever treatment is adopted, and it is easy for an observer sufficiently enthusiastic about any special form of therapy to ascribe this improvement to his treatment and not to nature.

Motives and Mechanisms of the Mind. By E. G. HOWE, M.B. Pp. xiii., 260. Illustrated. London: The *Lancet*. 1931. Price 10s. 6d.—Many books have been written on psychopathology and psychotherapy in the last ten years, and a new volume on the same subject must necessarily be more critically approached than would have been the case a decade ago. These twelve lectures were delivered to a post-graduate course, and they merit the highest praise, for they sum up modern thought on the subject in a clear and attractive style. If the reader expects some new and original contribution he will be disappointed, but the author is not to blame, for he has not set out to give this. For postgraduate teaching also a correct proportion has been maintained, since eleven and a half chapters are devoted to the "physiology" (*i.e.* psychology) and pathology of the subject and a half to treatment. The author is critical of all "theories," but applies what we have learnt from the great analytic schools with sound common sense. He traces the development of our unconscious and conscious motives, and shows how they influence our behaviour both individually and collectively. If the practitioner troubles to study this book thoroughly, he will neither scoff at what he does not understand nor rush in where the angels fear to tread in an access of enthusiasm for a subject which he thinks others do not understand.

Rheumatoid Arthritis and its Treatment. By VINCENT COATES, M.C., M.D., M.R.C.P., and L. DELICATI, L.M.S.S.A. Pp. xv., 114. Illustrated. London: H. K. Lewis & Co. Ltd. 1931. Price 6s.—This small monograph consists, as the sub-title suggests, of "Studies from the Royal Mineral Water Hospital, Bath." Though somewhat brief, it should prove useful by showing that something besides physic may be given for arthritis. The chapter on joint treatment is good as far as it goes. Stress is rightly made on the prevention of contractures. Perhaps more might have been said with regard to exercises, though it is good to find that breathing exercises are not ignored. The focal infection bogey is put in its proper place. Some of the illustrations might be improved upon.

Studies in the Photo-activity and Therapy of the Tungsten-Titanium Arc. By J. BURDON-COOPER, M.D., F.R.C.S., and A. ROBERTS, F.R.C.S. Pp. 85. Illustrated. Bristol: John Wright & Sons Ltd. 1931. Price 10s.—The book is a record of experimental and clinical work in actinotherapy with an open arc lamp, using special electrodes of an alloy of tungsten, titanium and chromium. The authors claim that these electrodes give a continuous spectrum, and that the addition of titanium intensifies those regions where the tungsten spectrum is weak, while the resulting spectrum more nearly resembles that of natural sunshine. The book is divided into two parts: (1) experimental; (2) clinical. The experimental part of the book is very convincing, dealing as it does with the penetration of the various portions of the spectrum and the absorption value of the rays. The experiments are ably demonstrated by the camera, and the photographs are of admirable quality, clearly showing the results arrived at. The authors are unable to explain all the phenomena found and frankly consider that the experiments are incomplete. Part II. contains chapters on the Crombie lamps and their application, and while the authors do not claim a final definite conclusion, the clinical details are carefully worked out and illustrative cases submitted, although the results would not appear to be markedly superior to ultra-violet radiation obtained from other sources.

Minor Surgery. By L. R. FIFIELD, F.R.C.S. Pp. viii., 439. 281 illustrations. London: H. K. Lewis & Co. Ltd. 1931. Price 12s. 6d.—The reviewer had the pleasure and privilege of reviewing the first edition of this work, about seven years ago. He found few faults and gave much praise, and in reading the second edition he sees no reason to withdraw any complimentary remarks, indeed it shows some improvement on the former. There is some slight addition in the section on the examination of a patient, and it includes a short account of the more common ear conditions not described in the first edition. The book should be in the hands of every student commencing his surgical work, and even those of more eminent attainment might well appreciate its sphere of usefulness. The author and reviser have omitted to include procedures and apparatus whose use has been discarded for the past forty years, and in this respect there is a distinct difference between this and other volumes of similar scope. It is a sad catastrophe which has robbed the medical profession of any prospect of further works from the pen of so prominent a man and so promising a writer as the late author.

Diagnosis in Joint Disease. By N. ALLISON, M.D., F.A.C.S., and R. K. GHORMLEY, M.D. Pp. xi., 196. Illustrated. London: Oxford University Press. 1931. Price 52s. 6d.—This monograph represents six years' intensive study by two experienced observers of various joint diseases, 289 cases actually forming the basis of the thesis. It is an essentially practical book, dealing with theories of causation and etiology only so far as these are necessary to elucidate or justify classification. All the more important diseases, *e.g.* tuberculosis, pyogenic infection, traumatic arthritis, etc., are dealt with by means of a series of clearly-described case reports, illustrated by X-rays taken at different stages of the disease and by several microphotographs of tissue removed at operation. For purposes of reference these case reports, and especially the correlation of the pathological with the clinical aspects, form a most valuable storehouse of information. The general production of the book and of the illustrations is excellent, but we think it unfortunate that coloured photography has been used for some of the coloured plates, because such reproductions do not give the necessary characteristic definition.

Emergency Surgery. Volume 2. By HAMILTON BAILEY, F.R.C.S. Pp. xvii., 415. 430 illustrations. Bristol: John Wright & Sons Ltd. 1931. Price 25s.—This volume is a worthy companion to its fellow on abdominal emergencies. The style is pithy and pleasing, and all the post-war additions to surgery of head, chest and limbs are included. The illustrations are admirable in quality and quantity. The course and treatment of septic infection of the hand and fingers are dealt with in a first-rate form after the teaching of Kanavel. Concise and correct advice is given on coping with injuries to bone and soft parts of the limbs, but, to be quite up to date, there should be mention of Kirschner's transfixion wire for extension. Blood transfusion has the praise and place that it deserves. It is good to see Bristol represented by the Ear, Nose and Throat Section contributed by Mr. Eric Watson-Williams, and it is pleasant to see Mr. Chitty's successful iodine treatment of actinomycosis recognized, even though the text-book is one of emergency surgery.

Technique and Results of Grafting Skin. By H. K. CHRISTIE, M.S., F.R.C.S. Pp. xii., 67. Illustrated. London: H. K. Lewis & Co., Ltd. 1930. Price 7s. 6d.—The title of this small volume aptly describes its contents, and little can be added to enlighten the prospective reader. The writer

deals with the recognized types of skin graft, their application and chief indications, concisely and without any elaboration, bias, padding, or phrases of laudatory comment on his own achievement. The outstanding feature is the apparent success of large Wolff grafts. A short history of a limited number of cases is given. The book should be of value to those who contemplate the undertaking of plastic surgery without the backing of practical experience.

The Genesis of Cancer. By W. SAMPSON HANDLEY, M.S., F.R.C.S. Pp. xix., 258. Illustrated. London: Kegan Paul, Trench, Trubner & Co., Ltd. 1931. Price 21s.—Mr. Sampson Handley's main thesis is that cancer is due to the effects on the epithelium of long-standing lymphatic obstruction. He begins by showing the true character of the lymphatics of the skin, which is given obscurely or erroneously in the text-books. They commence as blind, tube-like vessels, one in the centre of each papilla of the skin, and pour lymph into collecting vessels in the dermis, which drain an area of skin about half an inch across, and show little or no lateral anastomosis with other areas. Plunging deep, these vessels enter the general freely-anastomosing plexus in the deep fascia, from which main lymphatic trunks carry the fluid to the nearest lymphatic glands. When the lymphatics of the papillæ and dermis are obstructed by inflammatory overgrowth of their living endothelium, the epithelium of the skin grows upwards and downwards, and a papilloma results. Sections of papilloma show the obstructed lymph-vessels in the papillæ and in the dermis. Chronic obstructive lymphangitis of characteristic "stag-antler" pattern can be demonstrated in lupus, in warts, in paraffin dermatitis, in the irritation produced by rubbing tar into a mouse's skin, and in X-ray or radium dermatitis, all of which are precancerous conditions. In pigmented moles the lymph-vessels in the papillæ of the skin are dilated and empty; here, too, there is a tendency to malignant degeneration. The author thinks that cancers of the stomach and intestine usually arise in adenomatous polypi, and that these are due to lymph-stasis, but "the question needs further investigation." Cancer of the breast, as Sir Lenthal Cheatle and others have shown, begins as a proliferation of the epithelium lining the ducts of one or other quadrant of the mammary gland. The epithelial overgrowth is papillomatous or "laciform" in character. Cheatle gives no clear explanation as to why this overgrowth occurs. Sampson Handley points out that in cases of chronic mastitis

(="proemial breast" of Cheatle) the ducts are surrounded by dilated lymph-spaces, and, at a later stage, by hyaline fibrous tissue, which he believes is the result of inflammation and obstruction of the lymphatic vessels. The sequence of events is as follows: infection of the periductal lymphatics by germs entering at the nipple; lymphatic inflammation and obstruction; wart-formation in the ducts; cancer. It is a fascinating book, and the theory is, at least, entitled to respect. One wonders if it is not *too* simple. In biology simple explanations are apt to prove fallacious.

Wayfaring in a Splint. By OTTILIE WALLACE. Pp. x., 52. Illustrated. London: Oxford University Press. 1931. Price 2s. 6d.—This small volume describes the experiences of one who was condemned for many months to the wearing of a caliper splint. The pitfalls which await such a patient are many and varied, and are oft-times such as would not be anticipated by the sound of limb. The author depicts these traps for the unwary with a vivid personal touch, and she has devised ingenious ways of avoiding and circumventing them. Her dodges for taking a bath or even getting into bed make quite amusing reading. Most doctors could pick up useful hints worth passing on to any patient who is learning to walk in a splint, while the book should prove a real boon to convalescing fracture cases.

Editorial Notes

A Short History of the Bristol General Hospital.

The Bristol General Hospital celebrates the centenary of its foundation this year. In connection with this event Dr. J. Odery Symes has written a short history of the Charity. From the beginning to the end the book is full of interesting information. The first chapter opens with a quotation from the first report of the Committee which charged itself with the task of founding the new hospital in 1831, the wording of which has a delicious fragrance of the long ago. It refers to "the well-known fact that the Bristol Infirmary has for some time past been incompetent fully to answer the demands made upon the Charity." It is true that the reason given is lack of funds, but we suspect the word "incompetent" was not a wholly accidental choice. As Dr. Symes remarks a little later, "the Infirmary was a stronghold of Toryism." We regret that he has lifted so small a corner of the veil; these bygone controversies and hostilities form piquant reading for posterity. From the outset there was an attempt made to establish a "paying ward" to which lady subscribers might send their maids for a small weekly payment. But this was unsuccessful, only £60 in fees being recovered in eight years. There was also a "paying dispensary" attached, where armed with a subscriber's note a mechanic or labourer might receive advice and medicine for six weeks on

payment of 3s. 6d. This plan likewise failed. Dr. Symes names as the real founders George Thomas and Joseph Eaton, two close friends, both of whom were Quakers. The Hospital was formally opened on 1st November, 1832, and it is noteworthy that the Committee regarded the education of medical students as being almost as important a function as the care and relief of the sick in the institution.

In the early days the difficulties of obtaining suitable nurses were those common to all hospitals at that time: but Dr. Symes considers that in 1835 it was fairly efficient, and it is described by contemporary authority as "humane."

Changes in the medical and surgical staff were frequent at first, but in many instances the physicians and surgeons who resigned were re-appointed later. It is regrettable that the Bristol General Hospital possessed no "Richard Smith" to leave on record the inner history and gossip of these comings and goings. Evidently Dr. Fairbrother, who resigned his physicianship in 1853 and was elected in 1856 to the Bristol Royal Infirmary was a man to have met. For his colleagues at the Bristol Royal Infirmary had to write to their Committee asking that his statements should be accepted only on his own personal responsibility. Dr. Symes is sometimes almost too reticent; for instance, he relates that when J. G. Swayne was appointed Physician-Accoucheur it was on condition that he handed over all operations to the surgeons. He concludes, "This rule, however, gradually fell into disuse." Was it really as peaceful a decay as that?

Full justice is done to the influence of men like Symonds and the Fripps, but is a pity that the description of their work, both inside and outside

the Hospital, is so compressed that it is difficult for a reader to form any real estimate of their personalities and attainments from this brief history. If one may venture a criticism, we could well spare the accounts of unimportant bazaars and devices for raising funds or descriptions of properties bought and buildings erected in order to know more of the men and women who imparted life to the buildings.

The history of the later years of the Bristol General Hospital is one of almost uninterrupted prosperity: necessary extensions have been financed by many munificent benefactors, public subscriptions have been increased, and at present the Bristol General Hospital may justly court comparison with any general hospital in the country.

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The "Lancet" Commission on Nursing.

THE Final Report of the *Lancet* Commission on Nursing has now been published. In our issue of Autumn, 1931, we remarked that we should be interested to see how the *Lancet* would propose that hospitals should obtain the nursing staffs they need. Section XIII of the Final Report contains the whole of the recommendations (sixty-one in number) made by the Commission. It is important to observe that these recommendations have the unanimous approval of the Commission. We do not propose to reprint the whole of the recommendations, as the Report can be obtained from the *Lancet* offices for 2s. 9d. post free. They deal with:—

(*a*) *The Gap.*—This means the time between leaving school and attaining the age at which girls can begin nursing. It is recommended that there should be facilities for studying

anatomy, physiology and hygiene, so that part of the Preliminary State Examination for Nurses may be passed before entering hospital. A wise and feasible plan.

(*b*) *The Cost of Training ;* (*c*) *Salaries of Trained Nurses ;* (*d*) *Salaries of District Nurses ;* (*e*) *Superannuation.*—Various recommendations are made under these headings, designed to make the nurse's curriculum and career something approaching a livelihood, and less of a life of self-denial ending only too often in penury.

(*f*) *Hours of Duty.*—Many improvements are recommended.

(*g*) *Conditions of Admission and Service.*—It is suggested that the initial contract should be fairer to the probationer than it is at present, whilst the living accommodation and the disciplinary rules should be modernized.

(*h*) *Professional Education.*—Recommendations are made to ensure adequate instruction in recognized training hospitals, as well as to improve the State Examination. There is an irresistible demand put forward that the Final Examination should be confined to nursing treatment, and should not include questions on systematic medicine, surgery, gynæcology or psychiatry. Hitherto the Final State Examination has been adversely criticized on this score.

(*j*) *Recognition of Previous Training.*—It is hoped that some scheme may be evolved for such recognition.

(*k*) *Domestic Work in Hospitals.*—Sufficient ward-maids are recommended to relieve nurses of domestic duties not directly concerned with the patient.

(*l*) *Staffing of Non-Approved Hospitals.*—This recommendation is sufficiently bold an innovation to warrant its being reproduced in full and praised without stint. It is even worth enforcing by special legislation :—" Hospitals which are not approved by the General Nursing Council should not seek to enlist probationers for training, but should be staffed by trained nurses and domestic workers."

(*m*) *Tuberculosis Hospitals.*—It is advised that nurses trained in tuberculosis work should have their names placed in a special section of the " Infectious Diseases " Register ; also that sanatorium work calls for higher pay and longer holidays.

(*n*) *Mental Hospitals.*—Various admirable recommendations are made.

The Report deserves the highest praise and the closest study. Section II, describing the "Evolution of British Nursing," is a scholarly and critical contribution to Social History.

In one paragraph (Section III, 32) dealing with the present position the Report says (we do not know with what degree of justification) that senior nurses ask: "What more do they (*i.e.* prospective probationers) want?" The main task of the Commission has been to answer this question. The Commissioners have faced the position of a shortage of nurses fairly and squarely, they have weighed the evidence impartially, and they have framed a series of recommendations which the nursing profession should seize upon as their "Charter" and the medical profession should insistently and persistently support.

Meetings of Societies

Bristol Medico-Chirurgical Society

The fourth meeting of the session was held in the Physiological Lecture Theatre of the University, on Wednesday, 13th January, 1932, at 8.30 p.m., the President, Dr. J. R. CHARLES, in the Chair.

The minutes of the previous meeting were read and confirmed.

Dr. T. B. WANSBROUGH showed skiagrams and Dr. A. D. FRASER pathological specimens, including one of the **Brain from a Case of Carbon Monoxide Poisoning.** Dr. FRASER explained the pathology of this specimen, with the aid of the epidiascope. The PRESIDENT described the clinical history of this case and another similar one, and Dr. ALEXANDER and Dr. DIX also spoke on the case.

Dr. H. H. CARLETON then read a paper on **"Trigeminal Neuralgia,"** which appears on page 47 of this issue.

The PRESIDENT, in opening the discussion, stated that he had seen many cases successfully treated by drugs, and

also some successes following avulsion. He regarded surgery as very drastic, and only to be used as a last resort. He suggested the use of diathermy in these cases.

Mr. G. F. FAWN described two cases successfully treated with diathermy after dental extraction had proved of no avail. He had also seen improvement following the use of ultra-violet rays, and suggested that the condition might sometimes be due to an ascending neuritis.

Mr. RENDLE SHORT congratulated Dr. Carleton on his paper, and agreed that injection was the method of choice. He used a general anæsthetic in these cases, using novocain first and watching the corneal reflex. He had not been so fortunate as Dr. Carleton in the matter of eye complications. He had found avulsion of the first division very good, and had no hesitation in advising operation if injection failed.

Mr. C. F. WALTERS said he had seen some depressing results from injection, including a case of cavernous sinus thrombosis. He would like to know the length of time over which these cases remained free from pain.

Mr. E. R. CHAMBERS emphasized the necessity of the care of the eye in these cases.

Colonel A. E. J. LISTER spoke of a case of hyperphoria following an injection.

Dr. A. T. TODD mentioned the value of trichlor-ethylene in these cases, and also of pyramidon combined with phenazone.

Mr. R. R. GARDEN spoke of the pathology of the keratitis which occurred in these cases, and suggested that all such eyes needed several months' treatment.

Mr. A. W. ADAMS wished to know the number of recurrences which had occurred in Dr. Carleton's series. He himself had seen six recurrences within a year in twenty-five cases. He used both the anterior and the lateral routes, and thought that a general anæsthetic was desirable. He had seen two damaged eyes, but thought that the risk was justifiable.

Dr. A. L. FLEMMING spoke of the technique in cases in which a general anæsthetic was used.

Professor E. W. HEY GROVES said that his own view was that treatment should start with drugs, followed by injection if these failed, with operation if injection proved of no value. He thought that the results of injection were often temporary, and had seen the greatest successes and also the greatest disasters following removal of the ganglion. He suggested injection following exposure of the ganglion by surgery.

Dr. W. P. KENNEDY said that these patients were only too glad to have any treatment, however dangerous. He thought that some mention should be made of gelsemium.

Dr. CARLETON in reply said that all his cases had been treated with drugs before they came to him, and suggested that many cures attributed to drugs were really natural remissions. He had no experience of diathermy, and had seen several failures with avulsion. He did not like general anæsthesia, and said that injection was not more painful than an attack. He said that recurrences were due to injection of the nerve instead of the ganglion, and that nearly all his cases were comfortable after three years. Three cases had asked for another injection.

The fifth meeting of the session was held in the Physiological Lecture Theatre of the University, on Wednesday, 10th February, 1932, at 8.30 p.m., Dr. J. R. CHARLES in the Chair.

The minutes of the previous meeting were read and confirmed.

Dr. A. L. TAYLOR showed a number of pathological specimens.

The PRESIDENT introduced to the Society Dr. C. S. MYERS, who gave an address on **"Human Improvability,"** published on page 31.

Following the address questions were asked by the President, Mr. Walters, Dr. Rudolf, Dr. Frank Bodman, and Dr. Carleton.

Dr. MYERS replied.

Professor HEY GROVES proposed a vote of thanks to Dr. Myers for his address; this was seconded by Dr. R. G. GORDON and carried with acclamation.

Dr. MYERS thanked the Society.

The sixth meeting of the session was held in the Physiological Lecture Theatre of the University, on Wednesday, 9th March, 1932, at 8.30 p.m. Dr. J. R. CHARLES in the Chair.

Dr. BERGIN and Dr. A. D. FRASER showed respectively X-Rays and specimens.

Dr. G. E. F. SUTTON demonstrated a case of **Congenital Pseudo-hypertrophic Muscular Paralysis.**

Dr. A. T. TODD then read a paper on "**The Medical Treatment of Graves's Disease and Toxic Goitre,**" and showed several cases to illustrate the effect of his treatment.

The PRESIDENT, in opening the discussion, said that Graves's disease was a condition whcih had been successfully treated by many different branches of the profession. He had had two cases which had doubled their weight under medical treatment. He agreed that diet and rest were important, but also used codeia. He never gave iodine, and wondered if X-ray treatment of the adrenals might not prove dangerous from over-dosage.

Mr. RENDLE SHORT paid a tribute to Dr. Todd for the courage and originality of his work, but said that, in his opinion, surgery still remained the best treatment for cases of over six months' standing. He spoke of his own findings in Dr. Todd's cases, and said that they did not all come up to his standard of clinical cure. He had operated on well over one hundred cases with a mortality of 8 per cent.

Dr. H. H. CARLETON spoke of the value of surgery in this condition, and emphasized the importance of gentle surgery.

Dr. J. O. SYMES said that this was a serious disease, and quoted figures from his own experience of thirty cases with a 20 per cent. mortality, and none of those living able to do a day's work. He said that hydrofluoric acid had been a favourite treatment in his younger days.

Dr. C. E. K. HERAPATH would have liked more details of Dr. Todd's cases, and spoke of the value of surgery in hastening the cure. At the present time he was using radium and spoke well of the results.

Mr. S. J. H. GRIFFITHS was doubtful if Dr. Todd had proved his case, and said that the criterion of cure must be the patients' ability to return to their own work. He quoted figures from the Mayo Clinic and from his own series of ninety-four surgical cases with three deaths.

Dr. R. H. BURNETT suggested the possibility of giving sodium fluoride as a palatinoid.

Dr. FRANK BODMAN wished to know more of the biochemistry of these conditions, particularly with regard to the chloride content of the blood.

Dr. NEWMAN NEILD congratulated Dr. Todd, and hoped that he had started a return of these cases to the physician, similar to that which had occurred in the treatment of gastric

ulcer. He spoke of the value of the instillation of a drop of castor oil in the conjunctival sac in cases of exophthalmos.

Dr. G. E. F. SUTTON spoke of the value of codeia as used by the President, and of the use of the basal metabolic rate in diagnosis and control.

Dr. D. A. ALEXANDER mentioned the increase in the number of cases in recent years, and spoke of the importance of the psychological attitude of the medical attendant.

Dr. R. C. CLARKE spoke of the difficulty and importance of exact diagnosis in these cases, and said that successes had been claimed for many peculiar treatments in the past.

Dr. TODD, in reply, said that this was not a "stunt" treatment. The cases he had shown were all recent cases under treatment, and that they had undergone a very severe test in being shown to a crowded meeting. There were forty-four other cases, nearly all of whom were back at their work. He did not think there was any danger of Addison's disease arising as a result of X-rays to the adrenals. He was very interested to hear of the hydrofluoric acid treatment, but pointed out the difficulties in dispensing this drug. He thought there was little value in the basal metabolic rate, and did not use it now. He considered that his treatment was perfectly safe.

The PRESIDENT summed up the discussion in a few words.

The Medical Library of the University of Bristol,

WITH WHICH IS INCORPORATED

The Library of the Bristol Medico-Chirurgical Society.

The following donations have been received since the publication of the list in December, 1931.

	March, 1932.
A. G. Timbrell Fisher, Esq., M.C., F.R.C.S. (1)	1 volume.
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PLATE I

A Case of Suprarenal Hypertrophy.
(Dr. J. R. Charles.)

PLATE II

A Case of Suprarenal Hypertrophy.
(Dr. J. R. Charles.)